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with CHEMICAL & METALLURGICAL ENGINEERING

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JAMES H. McGRAW, Jr., *President;* CURTIS W. McGRAW, *Senior Vice-President and Treasurer;* JOSEPH A. GERARDI, *Secretary;* NELSON BOND, *Director of Advertising;* EUGENE DUFFIELD, *Editorial Assistant to the President;* and J. E. BLACKBURN, Jr., *Director of Circulation.*

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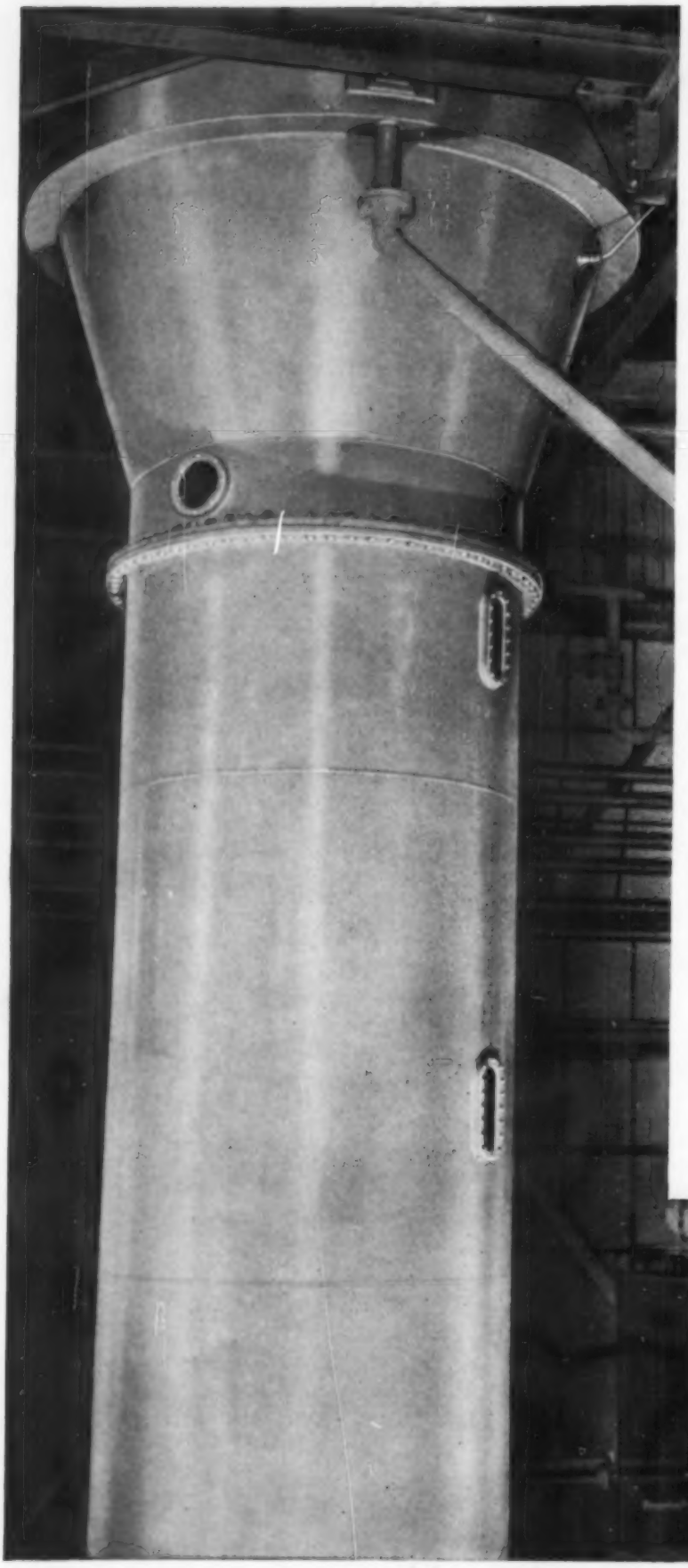

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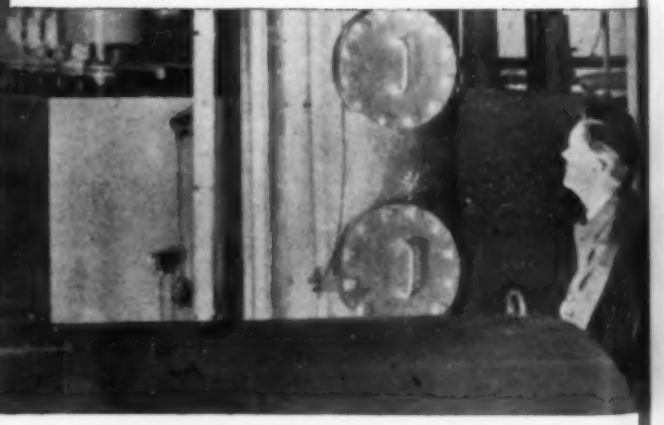

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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

Volume 55 APRIL • 1948 Number 4

Largest nitrate plant in Europe is planned by Norsk Hydro. Installations of Norsk Hydro at Heröya, Norway, will be expanded. Output will be boosted from the present 400,000 tons of nitrate a year to 750,000 tons. This will bring Norsk Hydro's total nitrate production from all plants to 1 million tons a year. The job will cost $26 million. Over-all aim is to increase Norway's production of fertilizers by 60 percent above the prewar rate by 1950, with all the increased output to be exported. Norway hopes to trade with Eastern Europe as well as with the Marshall Plan area.

•

Control of the Ruhr may be vested in an international economic directorate. In this compact management group all participating powers would be represented, with most nations of Western Europe invited to take part. Actual operation of the Ruhr's industries would be up to the Germans, with decisions on such matters as policy, finance and allocations made by the top international management. Europe depends on the Ruhr not only for coal but for iron and steel, heavy machinery and chemicals. Chemical industry is concentrated in the coal-rich Ruhr. Truly, it is a valley of decision.

•

Interzonal trade in Germany has been stymied by the latest Russian maneuver. Soviet-owned companies in the Soviet zone refuse to channel their production into current Soviet-zone programs for interzonal trade. Thus a shortage of industrial raw materials plagues Bizonia. The impact is felt most in such products as phenol, cresol, toluol, film and graphite electrodes.

•

Russia has a covetous eye on the oil fields of Iran. That is where Russia may make its first move with Russian troops, if it decides on such action. When he got back to Washington from Teheran, George V. Allen, former Ambassador to Iran, tipped off the State Department to this possibility.

Pretext for sending Red troops into oil-rich Iran has already been established. In a note dispatched to Iran last February, Stalin formally charged violation of the Russo-Iranian treaty of 1921. The treaty gives Russia the right to occupy Iran if a third power becomes active there in a fashion unfriendly to the Soviets. Stalin's February note accuses the United States of being the "unfriendly" third power.

•

Oil equipment for Eastern Europe may be held up in U. S. ports. The government is scrutinizing a $17 million shipment of oil equipment to Communist-dominated Rumania and Czechoslovakia. Now that exports to Europe are licensed, officials will screen carefully all applications. Red plans to throw a monkey wrench into ERP will not be overlooked.

Another factor to be considered is possible government seizure of the Rumanian oil industry, now partly owned by American and other foreign capital. And a joint Soviet-Rumanian official company has been formed. The American equipment might be taken over by this concern.

The Rumanian oil industry was slated to get $12 million in equipment, while another $5 million worth was for a synthetic fuels plant in Czechoslovakia. The orders were placed with Dresser Industries, Inc., of Cleveland, Ohio, before the State Department frowned on further exports to Communist-fringe nations because of ERP.

•

Yardstick for synthetic yarn prices is what the Office of Alien Property is trying to make out of two rayon companies it controls. Eight of the 10 directors of the board of North American Rayon Corp. and American Bemberg Corp. quit when

Photographs show vast size of limestone mine operation. Shovels are 1½ yard, electrically powered; trucks are Diesels.

World's deepest

LIMESTONE MINE

TO AUGMENT raw materials supplies, Columbia mined 2,200 feet for limestone—almost beneath its plant at Barberton, Ohio.

The operation is notable in a number of other ways. Modern equipment of great size—capable of moving 300 tons of stone per hour—was assembled underground. The stone is screened and crushed; then brought to the surface by a semi-automatic hoist which attains a speed of 2,000 feet per minute and automatically brakes and dumps at the top.

This is another of numerous developments pioneered by Columbia for improved production and service to industry . . . Pittsburgh Plate Glass Company, Columbia Chemical Division, Pittsburgh 13, Pa. Manufacturers of Soda Ash, Caustic Soda, Liquid Chlorine, Sodium Bicarbonate and other alkalies and related essential industrial chemicals.

COLUMBIA CHEMICALS

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PITTSBURGH PLATE GLASS COMPANY

David Bazelon, Alien Property's boss, refused to let them raise their yarn prices. Their competitors, among them Du Pont, American Viscose and Celanese, had increased prices by about 7c. a lb. last December, bringing prices to the present 74c. to 75c. Six seats on the new board, elected in March, were filled by OAP, now majority stockholder.

OAP took over the controlling stock interest last August, when it decided that the parent Netherlands corporation, Algemeene Kunstzijde Unie, N. V., was in part German-controlled. Now OAP, unexpectedly reversing its field, plans to sell its stock holdings in North American and Bemberg. It does not want them to get back into German hands. Nor does it want other big rayon producers to gobble them up.

●

Decision in the U. S. Gypsum case further abridged the rights and privileges of patent ownership. The Supreme Court unanimously outlawed the use of a patent by a single patent-owner and his licensees to fix prices on the output of an entire industry.

U. S. Gypsum has patents on the production of a superior wallboard with a closed edge. When it licensed its competitors to make the patented board, almost the whole industry got under a price-fixing umbrella. Together, these companies produced about 90 percent of all wallboard. This arrangement, said the Supreme Court, was carrying patent rights too far, clearly it was in restraint of trade.

In this case, the Supreme Court found two evidences of conspiracy: (1) industry-wide licensing agreements which fixed minimum prices and terms of sale of virtually all gypsum board made in the United States; and (2) price bulletins and policing activities by which U. S. Gypsum kept prices of licensees in line.

The decision was a victory for the Department of Justice. John F. Sonnett, chief of the trust-busters, warned other companies to overhaul their patent license policies and practices.

●

Licenses on some 3,500 patents in the dyestuffs, photographic, textile and chemical fields will be granted by General Aniline & Film Corp. The licenses will be available to all comers at reasonable terms on a non-exclusive basis. GAF's offer was worked out with Justice Department's Office of Alien Property, which controls the company through ownership of more than 90 percent of the capital stock. Alien Property officials hope by licensing these patents to give little business a better competitive break.

●

Red coup in Czechoslovakia has had many tragic aftermaths. Not all have made the headlines. Thus M. Martinek, general director of the nationalized chemical industry, has been sent on leave.

●

Caustic soda and soda ash producers powwowed with Commerce Department officials last month on a voluntary allocation program. Commerce, through its Office of Industry Cooperation, asked for an industry advisory committee. But more important, Commerce made strong medicine against the gray market in alkalis, especially caustic soda.

Shortage of caustic soda has boosted its world price as high as 15c. a lb. With Great Britain, France, Germany and Japan, once major factors in world alkali markets, pretty much out of the picture, exporters have been cleaning up on caustic. But when Commerce, through its OIT, refused to license exports at fancy prices, the price of caustic tumbled.

Soda ash is not much of a problem to government officials. They agree with trade sources that supply and demand are about even-up. New production coming in this quarter should eliminate any current shortage.

The manufacturers of caustic soda and soda ash agreed to set up an industry advisory committee to work with the government on voluntary agreements. They also agreed to organize a smaller "task force" for day-to-day contact with OIC.

●

Labor disputes in atomic energy plants may be settled by compulsory arbitration. Recent strike threats by CIO and AFL unions at the Oak Ridge, Tenn., plants run by Carbide & Carbon Chemicals Corp. have heightened this prospect.

When Carbide & Carbon took over the Clinton Laboratory at Oak Ridge from Monsanto, the AFL union there demanded that high wages and other benefits its members got from Monsanto be continued. President Truman had to invoke for the first time the national emergency pro-

(Continued on page 76)

Long ago ...buying valves was simply a question of "how many?"

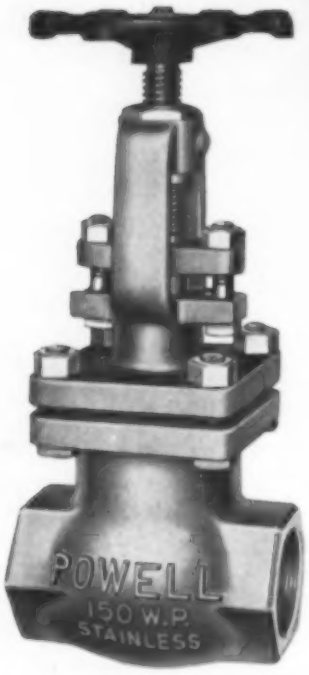

Fig. 1968—150-pound Stainless Steel Gate Valve with screwed ends, outside screw rising stem, bolted flanged yoke-bonnet and taper wedge solid disc.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through valve body.

Long ago, when valve making was in its infancy, all valves were pretty much alike. So no one worried about what kind of valves to buy. But because industrial flow control requirements were equally simple, almost everyone was fairly well satisfied.

But not everyone! Because Powell, not content to "let well enough alone," introduced the first regrinding globe valve in 1865 . . . and ever since then Powell has been producing "firsts."

And so today, to meet all the diverse and complex flow control requirements of modern industry, Powell makes a Complete Line of valves—not only in Bronze, Iron, and Steel, but also in the widest range of corrosion-resistant metals and alloys ever used in making valves.

As a result, there's still no need to worry about what kind of valves to buy—merely consult Powell.

The Wm. Powell Company, Cincinnati 22, Ohio

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POWELL

Fig. 2051—150-pound Stainless Steel "Y" Valve. Has flanged ends, bolted flanged yoke, outside screw rising stem and plug type disc.

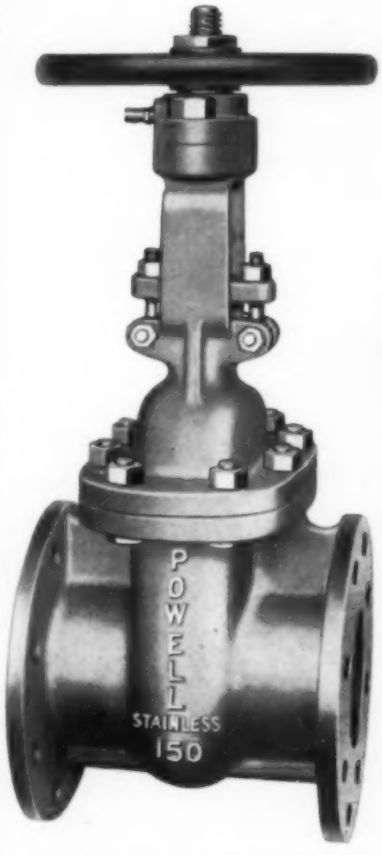

Fig. 2453-G—New, standard 150-pound Stainless Steel Gate Valve with outside screw rising stem, bolted flanged yoke-bonnet and taper wedge solid disc.

Fig. 2309 — Small Flush Bottom Tank Valve. Disc rises into tank to open valve. Sizes ¾" to 3", incl. Also available with disc lowering into valve to open (**Fig. 2310**). Sizes ½" to 3", incl. Other designs of Powell Flush Bottom Tank Valves are available in sizes 4" to 8", incl.

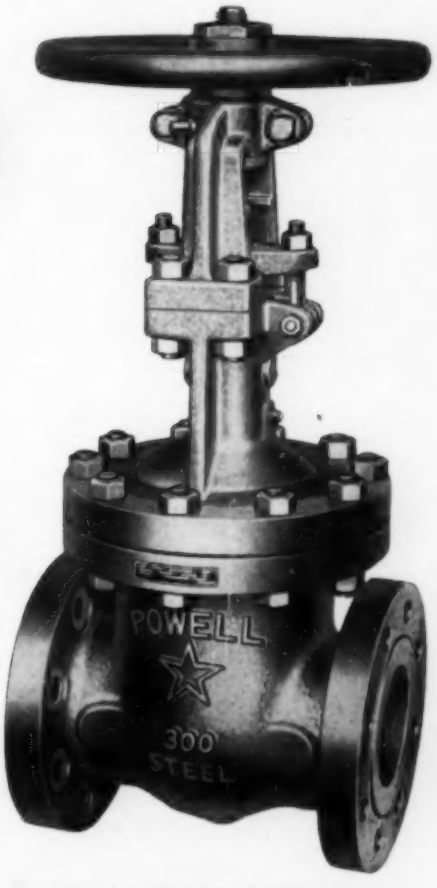

Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

VALVES

(Continued from page 73)

visions of the Taft-Hartley Law to forestall a walkout. In its first fact-finding report on the dispute, the three-man board of inquiry told Truman that "national safety limits the freedom" of the AFL union to strike.

Joint Atomic Energy Committee of Congress has been holding hearings. It seeks a way to end strike threats in atomic bomb plants. Both union and government witnesses favor some form of arbitration. But the CIO opposes legislation compelling it. Congress may come up with a plan to provide uniform wages and working conditions in atomic energy plants.

●

Employment in petroleum refining industry hit an all-time high in August 1947. After August there was a seasonal drop. But latest reports from 131 establishments, covering practically the entire industry, show that 173,250 were working in January. A net gain of about 1,200 workers is expected by May, with no further gain by July. Employment in petroleum refining will continue to increase gradually for years to come. Rate of voluntary separations last December was only one-half of 1 percent of the employment, the lowest rate of any manufacturing enterprise. Labor turnover in the petroleum industry has been extremely low.

●

Wage increases of 11c. an hr., as well as other benefits, were granted by Lever Bros. to 3,000 employees in its five plants. Lever Bros. granted this 11c. boost in hourly wages despite recent cuts of 5 percent in the prices of its soaps and shortening. Record productivity per man-hour during 1947 permitted the pay hike.

This fourth wage increase in two years brings straight-time earnings to $1.60 an hr. Since March 1946 Lever Bros. has put into effect direct wage increases and other fringe adjustments totaling 62c. an hr.

Uniform contracts were signed with the International Chemical Workers, AFL; the United Gas, Coke and Chemical Workers, CIO; and the independent Association of Employees at the St. Louis, Mo., plant. Other plants of Lever Bros. affected are at Edgewater, N. J.; Baltimore, Md.; Hammond, Ind.; and Cambridge, Mass.

●

High construction costs fret Du Pont. Out of its record 1947 gross of $795,538,075 Du Pont set aside a $20,900,000 reserve for excessive construction costs. This equaled about 20 percent of what Du Pont shelled out for plant expansion in 1947. New plants and equipment today cost more than double what they did in 1939. Setting up this reserve pared $1.51 off earnings on the common shares, bringing them to $9.88 a share. Du Pont's net income for 1947 was $120,009,760. Also taken out of the record gross was a $68,720,000 provision for federal income taxes.

●

Boom town, Kansas style, is Garden City, where Stanolind is building its $80 million synthetic gasoline plant. Initially, the plant will produce 6,000 bbl. of gasoline a day. U.S.I. has leased rights to an estimated 100 million pounds of byproduct chemicals that the Kansas plant will give off every year. All this looks like a chemical empire in the making. And the feverish rush is on.

Once this western Kansas trading center was dying in the dust. War brought a mild boom. But now the throngs and traffic are coming for keeps. The first drive-in movie is going up. A hotel will build a 100-unit cottage court. A theater chain will build a $250,000 structure combining a theater with stores and offices. This will be the most ambitious commercial construction in Garden City's history. Population has increased from 6,200 to 9,500 in eight years. Officials envision a community of 25,000 or more people within a decade. Already they are planning a bigger police force, more hospitals and utilities.

Some 4,000 workers will labor two years to build the Kansas plant. It will be fed by 400 miles of pipelines from 325 gas wells in the nearby Hugoton field. Rated most productive in the world, the Hugoton field has original reserves estimated at 14 trillion cubic feet of gas. And although experts have guessed it might run dry within 25 years, nobody in booming Garden City seems to care.

●

New solvent extraction process is the Bonotto system. It promises to increase output of vegetable oils. Production Engineering Co. has built a pilot plant at Memphis, Tenn., for Swift & Co. In this plant the Bonotto system will be employed to extract from cottonseed residue the oil remaining after mechanical extraction.

Improved design in the extracting equipment provides: (1) minimum creation of fines; (2) high difference of oil concentration between seed and solvent; (3) even and effective contact; (4) no unextracted solids by-

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Standard drive would have cost 54.8% more money than SPEEDAIRE

DRIVING a broke chest agitator, the Speedaire shown here saved a New York fibre products manufacturer $221. A standard worm gear unit of sufficient capacity to do the job would have cost 54.8% more money.

Speedaire also saved space and weight. A standard unit of equivalent capacity is 50% taller and longer and a third wider than Speedaire, occupying double the space and weighing considerably more than twice as much.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Co., 3273 East 80th Street, Cleveland 4, O.

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passing to reach outlet; (5) minimum extraction time; (6) economical extraction; and (7) low solvent-to-meal ratio.

The new system, according to Production Engineering Co., turns a batch operation into a continuous one. It can handle peanuts, copra or flaxseed. Widespread use of such solvent extraction systems would increase greatly the recovery of vegetable oils containing fatty acids.

●

Plastics from flaxseed meal are now sought by Canadian chemists. Researchers at the University of Saskatchewan hope to produce a plastic from flaxseed meal that will combine strength and durability with water-resistance. An industrial market for flaxseed meal, particularly in plastics, may replace its present major use as a livestock feed.

●

Butadiene may become an important raw material for production of synthetic organics. Chemists are intrigued by its highly reactive pair of double bonds. A program is quietly under way to make butadiene a major nylon raw material.

●

Aconitic acid is recovered as the calcium salt from bagasse by Godchaux Sugars, Inc., of Reserve, La. Esterified aconitic acid is used as a plasticizer in vinyls. It also has applications as a light stabilizer and, when sulphonated, as a wetting agent.

●

Cresylic acids are used by Magnolia Petroleum Co. in its Duo-Sol lube unit. When a shortage of such acids from coal threatened in March 1947, Magnolia began to purify its own output of crude acids. Now Magnolia markets purified cresylic acids. The acids are recovered during the caustic-treating of cracked gasolines at Magnolia's Beaumont, Tex., refinery. Acid content of the cracked gasolines is less than 1 percent. Crude acids in the caustic solution are sprung out by sulphuric acid. Distillation then separates phenol from the mixture of cresylic acid isomers. About 20,000 gal. a month are produced. Part of the output is used at the refinery, part sent to Socony at Paulsboro, N. J., and the remainder sold to chemical companies.

●

Methoxychlor insecticide now made by Du Pont is not dangerous to domestic animals and can be safely used on plants. Marlate, as it is called, has greater knock-down power than DDT. Active ingredient is bis-(methoxyphenyl)-trichloroethane.

●

Organic building block now made by Goodrich is beta-propiolactone. It is made by combining formaldehyde and ketene. The ketene comes from acetone or acetic acid. Possibilities abound for the new lactone. From it can be made acrylic esters, succinic acid, acrylyl chloride and acrylamides. Thus beta-propiolactone will be a boon to producers of plastics, synthetic resins and chemical rubbers.

●

Ethyl acetate production has been almost doubled by Monsanto. The solvent is a byproduct in polyvinyl acetal manufacture. High demand for polyvinyl acetals to go into safety glass and transparent coatings made the increased output of ethyl acetate possible.

●

Methanol and formaldehyde prices have been boosted by Du Pont. Up also are hexamethylene tetramine and paraformaldehyde. High raw material, production and shipping costs forced Du Pont's hand.

East of the Rockies, methanol in tank cars has been jacked up 4c. to 28c. a gal. Corresponding increases bring methanol in drums to 38.5c. a gal. for carload and 42c. a gal. for less-than-carload lots.

Regular-grade formaldehyde now sells for 4.2c. a lb. instead of 3.7c. a lb. Paraformaldehyde is up from 25c. to 26c. a lb. And technical-grade hexamethylene tetramine has gone from 26c. to 27.5c. a lb.

●

Chlorine and caustic will be coming from Southern Alkali's $10 million plant, one of the nation's largest, at Lake Charles, La. The H. K. Ferguson Co. has finished its job of converting the wartime magnesium chloride plant to chlorine and caustic production. The plant will produce daily 200 tons of liquid chlorine and 225 tons of caustic soda.

●

Electronic vulcanization is now a production-line procedure for certain extruded products in plants of B. F. Goodrich Co. Products with a sales volume of $45 million a year, including tubing, strip and channel stock, and rubber thread, are electronically vulcanized. Actual curing time for some products has been slashed from 1.5 hr. to 2 min. Handling during manufacture is also greatly reduced.

CHEMICAL ENGINEERING
with CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 APRIL 1948 SIDNEY D. KIRKPATRICK, Editor

Four, Five or Six Years?

CAN and should engineering education be geared to employment opportunities in the various fields? Is it fair to the student to provide and insist on long years in training for a career he cannot attain? Is it fair to our educational institutions to demand that they increase their staffs and facilities to accommodate all comers? Or should some attempts be made both to control the supply of engineering graduates and to direct their training more nearly to match future demands for engineering services?

These questions are being raised by some of our leading educators. Dean M. P. O'Brien of the University of California, is one of those who foresee the time—perhaps by 1950—when there will be an oversupply of engineers. As time goes on more and more engineering graduates will have to find employment outside of professional engineering practice. This raises the corollary question of general vs. specialized undergraduate curricula.

Cornell, Minnesota, and a few other schools are attempting to solve this problem by providing a 4-year general engineering program leading to the degree of Bachelor of Science in Engineering without designation of a professional specialty. For those who can qualify for specialized degrees, one or more years of professional training are required. This seems an efficient compromise between the specialized 4-year curricula given in most of our engineering schools and the straight 5-year course being introduced in a number of institutions.

Dean Thorndike Saville, in his last annual report to the Chancellor of New York University, proposed a re-alignment of objectives and curricula so that "career" training could be differentiated at the beginning of the senior year from the more specialized and technical education now provided by the usual professional courses. He argues that since fully half of today's graduates eventually go into administration, sales and other nontechnical positions, it would be better for them to devote their four collegiate years to more general courses in the basic scientific and engineering fundamentals, history, public affairs, economics and other non-technical subjects. Those who desire and have the aptitudes for more advanced studies in some particular branch of engineering should be encouraged to continue for a fifth year, after which they would receive the presently designated degree, such as Bachelor of Chemical Engineering. (The Saville proposal, which has much in its favor, is further explained in a letter to the editor on page 200 of this issue.)

A still further approach is to be seen in the so-called Basic Engineering program now in effect at Princeton. It does not call for a split into two "stems" at the end of the junior year. Rather it is a straight 4-year program designed to provide a broad engineering base with considerably more of the humanistic-social courses than is possible in the more specialized curricula. Basic Engineering vies in popularity with Chemical Engineering at Princeton, and Dean Kenneth H. Condit insists that it is equally tough.

The educators are looking to practicing engineers and engineering employers for help in solving some of these problems that are so important to the future of our profession. Their proposals could well be debated and discussed in conferences between university and industrial people in various parts of the country. For our own part, we are still uncertain about the value of the general curricula for the specialized needs of the chemical process industries, but we heartily applaud the idea of a 5-year course in chemical engineering that would (1) weed out those unqualified for the rigors of the profession, and (2) provide additional training in the social sciences and public affairs.

CHEMICAL and FERTILIZER PLANT of the Consolidated Mining & Smelting Co. of Canada, Ltd. at Trail, B. C.

Trail Refuses to Trail

SIDNEY D. KIRKPATRICK

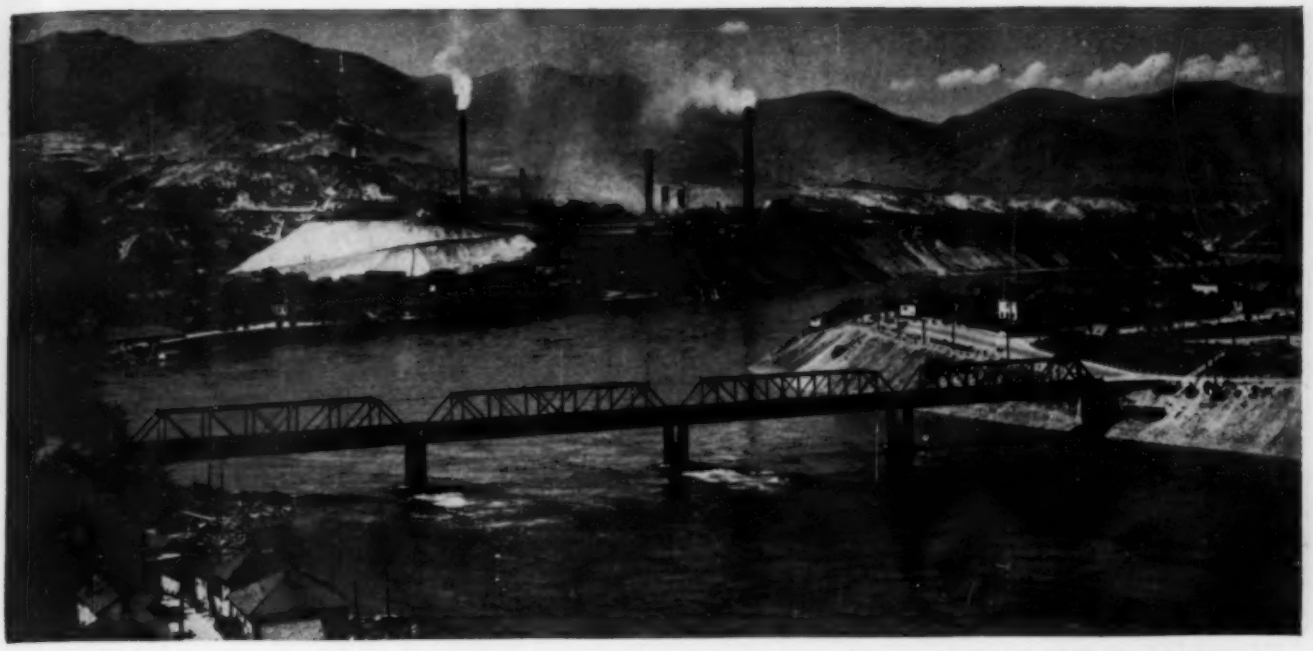
Editor, *Chemical Engineering*

Resourceful engineers in Western Canada's largest enterprise have developed many unique processes peculiarly applicable to local raw materials and facilities. Most notable include use of byproduct oxygen in contact sulphuric acid production, gasification of coal, zinc and lead smelting. Other striking advances have been made in the technology and production of nitrogenous and phosphatic fertilizers.

TRAIL now has its sulphur problem *in reverse*. When I first visited the great chemical and metallurgical operations in British Columbia in 1931, the Consolidated Mining and Smelting Co. of Canada, Ltd., had just completed a $10,000,000 chemical and fertilizer works designed primarily to utilize the sulphur in its waste smelter gas (see *Chem. & Met.*, Nov., 1931, pp. 626-31). On my second trip, seven years later, the facilities for synthetic-ammonia, sulphuric-acid and phosphoric-acid production had almost doubled, but still

HYDROGEN production for ammonia comes from more than 3,200 of these Trail-type electrolytic cells. D.c. power is 670 and 830 volts

AMMONIA is stored in Hortonspheres like this in Consolidated's new Warfield, B. C. works



METALLURGICAL PLANTS with 400 ft. high stacks. Discernible at left is plateau where chemical plant is situated

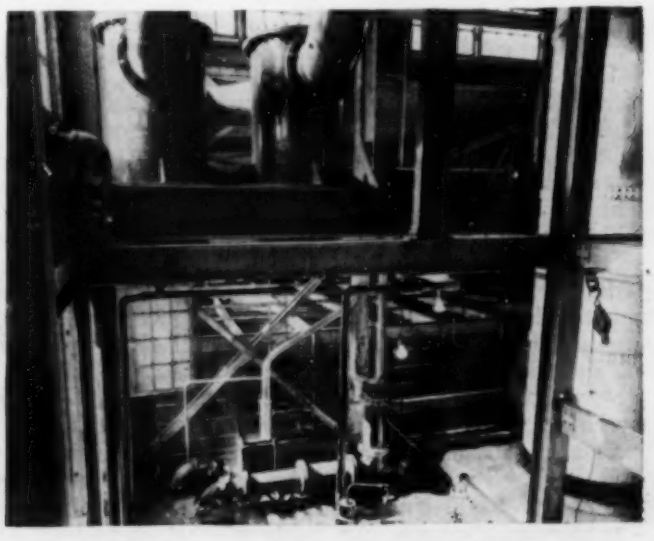
In Chemical Pioneering

they could not absorb all of the sulphur in the incoming sulphide ores. So Trail's resourceful engineers pioneered a process to recover elemental sulphur itself. By July 1938 there was more than 20,000 tons of solid sulphur in the Cominco stockpile. Then came the war and Cominco's sulphur pile quickly disappeared in the tremendously expanded operations. And so when John Callaham and I visited Trail last November, we were not surprised to find the smelter actually burning iron-sulphide tailings just to get the additional sulphur needed for the ever expanding chemical and fertilizer operations.

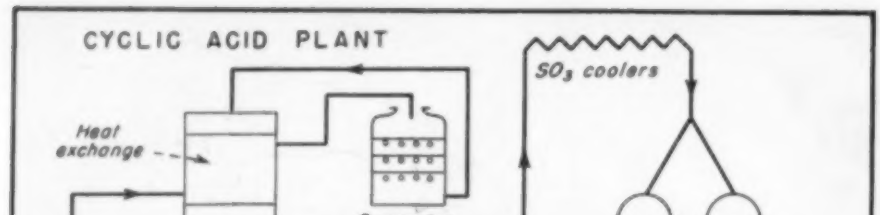
Behind this reversal of the sulphur problem are some of the great chemical engineering advances of our times. Trail still pioneers processes peculiarly applicable to its chemical and metallurgical resources, which are without parallel anywhere else in the world. Byproduct sulphur, byproduct oxygen, low-cost hydrogen and nitrogen, coal and phosphorus are the six pillars that support Cominco's program of integration and interpendence.

Most striking of these advances from the standpoint of technology has been the development of the cyclic process of sulphuric-acid manufacture. This was first reported by A. F. Snowball at the Chemical Institute of Canada meeting last summer in Banff. (See *Canadian Chemistry and Process Industries*, Dec. 1947, pp. 1110-4). Here is how the process came about. Early in the war the management found it necessary to double sulphuric-acid output without building a new plant. This was accomplished, in part, by redesigning an old contact unit so that it could handle on a cyclic basis

SULPHURIC ACID plants utilize byproduct sulphur gases from the smelters and convert them into sulphuric acid



VIEW of absorber towers, right; acid dilution equipment, below; spray catchers, upper left; coke filter in back



FLOWSHEET of cyclic sulphuric acid process used in redesigned contact unit

a mixture of 25 percent sulphur dioxide and 30 percent oxygen. Additional heat-transfer equipment was installed. Necessary changes were made in the two catalyst converters. Thus the capacity of the obsolete 35-ton per day unit was soon approaching 200 tons of 100 percent sulphuric acid. Except for occasional shutdowns, it has operated at that rate ever since.

Pure sulphur dioxide which was formerly reduced to elemental sulphur is supplied by the plant I described in the 1938 article (see *Chem. & Met.*, Sept. 1938, pp. 483-5). Low-concentration SO_2 from the metallurgical operations is absorbed in aqueous ammonia to form ammonium bisulphite, which is drawn off when it reaches a strength of about 5 to 6 lb. of SO_2 per gallon. It is then treated with concentrated sulphuric acid to liberate almost pure SO_2 and a practically saturated solution of ammonium sulphate.

Pure oxygen is a byproduct of the electrolytic hydrogen required for the ammonia synthesis. More than 3,200 cells of Trail's own design are used to electrolyze 28 percent KOH solution. They operate on d.c. power at 670 and 830 volts provided by ten mercury-arc rectifiers.

Before I describe some of the equipment and the changes in design that were required to revamp this 15-year old acid plant for its new role, I suggest we study the flowsheet for the cyclic process that Mr. Snowball first presented at Banff (see above). You will notice that the circulating gas stream (of 6,000 cfm.) moves from the blowers through the heat exchangers to the converters. (In the old plant these were packed with platinum catalyst in a semi-poisoned condition; in the new plant a special vanadium catalyst is used.) The converted gas, containing SO_3 at high temperature, is cooled in the heat exchangers, then in air-cooled pipes, before reaching the absorbers where the SO_3 is removed by contacting with 98.4 percent H_2SO_4. The cycle is completed when the gas passes through the spray catchers and coke filter ahead of the blowers. Measured quantities of oxygen and 100 percent sulphur dioxide are added during and after the absorption to replace the sulphur trioxide and to maintain the concentrations of the gases at the ideal operating percentages of 25 percent SO_2, 30 percent O_2 and 45 percent N_2. Mr. Snowball reports that the plant has an operating efficiency greater than 99.5 percent.

The converter is the heart of the cyclic process. Each is a welded steel shell, 9 ft. in inside diameter and 14 ft. 6 in. high, containing superimposed cast-iron trays on which the catalyst lies. Inserted below each tray is a horizontal bank of 1-in. steel tubes through which cooling air is circulated to control operating temperatures.

Gases leaving the converters at approximately 520 deg. C. are cooled to 175 deg. C. in the heat exchangers. Their temperature is further reduced to about 60 deg. C. by passage through a series of 4-in. pipes exposed to the atmosphere. Additional heat is removed from the gases in the absorption towers by cooling the circulating acid in cast-iron trombone coolers over which cold water cascades.

Fortunately, the original 35-ton plant had sufficient absorber capacity to take care of the greatly increased production resulting from the new process. The absorbing towers, of which there are six, are 5 ft. 4 in. in diameter, 24 ft. high and of riveted steel construction. They are brick-lined and packed with 3-in. spiral packing.

Spray removal became a critical problem because of the high velocity of the gas stream. To solve it, spray catchers of conventional type are followed by a coke filter. This is a lead box, 28x28x8 ft., which is filled with graded coke through which gas ascends.

In operation it is necessary to maintain a constant composition in the gas at the outlet of the coke filter. This is accomplished by careful control of the intake of SO_2 and O_2 into the system. Mr. Snowball reports that high production rates require a flow of 1,000 cfm. of SO_2 and 500 cfm. of O_2 to maintain a concentration of 25 percent SO_2 and 30 percent O_2 in the circulating gas.

With its controls centralized in a single instrument panel, the new unit can be operated by only one man on each shift. All temperatures in the converter system are measured and recorded by a Leeds & Northrup 6-point recorder and 12-point indicating pyrometer. The SO_2 concentration is indicated and recorded by an I&N Micromax, and oxygen is analyzed by a Beckman analyzer. Flow measurement of SO_2 is recorded by a Bailey recording meter; oxygen by a Foxboro. Water for dilution of the acid is measured by a rotameter, while acid strength of the 98 percent acid is recorded by conductivity meters.

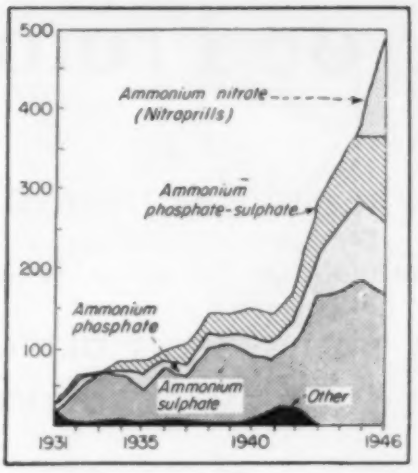
Catalyst and Corrosion

Development and successful operation of this new process were not accomplished without the usual share of difficulties. Catalyst behavior at the abnormally high operating temperatures and gas concentrations required extended research. Serious conditions of corrosion occur in the converters and heat exchangers. A great deal of time and effort was expended in laboratory and plant studies to select resistant materials of construction. Proper control of catalyst and reaction temperatures by means of the air-cooling tubes that traverse the converters was possible only after many careful surveys and heat balances. Fortunately for the chemical engineer facing similar problems, Mr. Snowball's original paper contains a mass of invaluable reference data and detail which I cannot include in this brief summary of my inspection tour at Trail.

Magnitude of Operations (1946) at Consolidated Mining & Smelting Co., Ltd. Tons per Day of Output or Capacity

Final Products	Output
Ammonium nitrate[1]	470
Ammonium phosphate (16-20-0)	300
Ammonium phosphate (11-48-0)	260
Ammonium sulphate	460
Fertilizers, total	1,490
Antimony	1.0
Bismuth	0.3
Cadmium	1.0
Gold, oz.	120
Lead	450
Silver, oz.	16,000
Tin	1.2
Zinc	360
Men and Materials	
Employees[2]	8,475
Ammonia[4]	480
Coal consumed	415
Coke consumed	230
Fuel oil used, gal.	2,200
Nitrogen[5]	138
Phosphate rock used	630
Power, 1,000 kwh.	4,000
Sulphuric acid[3]	1,200

[1] Nitraprills, made at Trail and Calgary. [2] July 1947. [3] Capacity. [4] Capacity, Trail and Calgary. [5] Capacity, Trail only.



FERTILIZER PRODUCTION, thousands of short tons per year from 1931 to 1946

Oxygen from Trail's electrolytic cells was put to other interesting uses during the war. Cominco engineers pioneered the commercial application of a fixed-bed process for the complete gasification of coke to yield a raw synthesis gas from which hydrogen could be produced for ammonia synthesis.* The process permits the use of oxygen in standard producer gas equipment. As described by Prof. C. C. Wright of Pennsylvania State College's Division of Fuel Technology (see *Chemical Engineering*, June 1947, pp. 114-15), the studies were extended to test work on the oxygen gasification of anthracite. From further research along these lines may come the ultimate answer to the important problem of how gas for chemical and liquid fuel synthesis may be obtained from solid fuels under American conditions.

Byproduct oxygen has also been used experimentally in other chemical and metallurgical operations at Trail. But these cannot yet be discussed in detail. Oxygen instead of air in zinc smelting or in the oxidation of ammonia to nitric acid are interesting examples of such studies.

But these are only a few milestones in the sweeping advances made by this productive company during the past dozen years. Since 1936 Cominco has upped its total fertilizer output almost 400 percent to reach a production close to 500,000 tons a year (see accompanying table and chart). The 1947 figures are not yet available, but the 1946 increase over the previous year was 25 percent—practically all ammonium nitrate. This nitrate is produced as a pelleted, free-running, non-caking fertilizer known as "Nitraprills" and is marketed by Cominco under the trade mark, "Elephant Brand." These products are a big factor in world markets. In 1946, 78 percent of Cominco's ammonium phosphate, 94 percent of its sulphate and 98 percent of its nitrates were shipped outside of Canada.

In 1946 Consolidated purchased two chemical plants from the Dominion government for $7,500,000. These had been built in 1941 and operated by Cominco during the war for the Canadian government. The largest, near Calgary, Alberta, burns natural gas from Turner Valley oil fields to produce nitrogen. This, together with hydrogen made by the reaction of natural gas and steam, is converted into anhydrous ammonia. The Calgary plant has a daily capacity of 240 tons of ammonia and 180 tons of ammonium nitrate. The new Warfield, B. C., plant produces 320 tons of nitrate daily.

Nitrogen Supply

Nitrogen for ammonia at Trail is made in three standard Claude liquid-air units, each with a daily capacity of 46 tons of nitrogen. Hydrogen is produced by water electrolysis in 3,215 Trail-type cells similar to those described by B. P. Sutherland in a paper presented before the Electrochemical Society in Milwaukee, Wis., in April 1944.

Nitrogen and hydrogen are mixed in proportions of 1 to 3 by volume, are compressed to about 250 atm. and converted to NH_3 by circulating over an iron-base catalyst maintained at 400-500 deg. C. Conversion per pass is about 15 percent. Part of the liquid NH_3 is vaporized and used to produce fertilizers; the remainder is dissolved in water to form concentrated aqueous ammonia for absorption of SO_2. The Trail ammonia plant has a daily capacity of 240 tons.

Phosphoric acid of 32-33 percent P_2O_5 is made by the wet process in a plant having a total intake of 650 tons of rock per day. Fluorine is recovered as fluosilicate which is largely used in the firm's metallurgical operations. The fertilizer section has three units with a total daily capacity of 700 tons of ammonium phosphate containing (11 percent N_2 and 48 percent P_2O_5) and ammonium phosphate-sulphate containing (16 percent N_2 and 20 percent P_2O_5). Ammonium sulphate is made by direct neutralization of sulphuric acid with ammonia, or by evaporating and crystallizing the sulphate formed on acidifying the absorption solution previously mentioned. This plant has a capacity of 450 tons daily of ammonium sulphate using Oslo crystallizers, centrifuges and dryers. In addition there are three saturators that can be used for direct ammoniation.

Nitric acid for ammonium nitrate is made by catalytic oxidation of ammonia. This acid is neutralized with NH_3, the solution concentrated by evaporating, and then "prilled" by dropping it down a tower countercurrent to a flow of cool air. This product, after conditioning with diatomaceous earth, becomes the Nitraprills of commerce.

This important prilling technique was developed at Calgary by a plant engineer equipped only with good imagination, a nail-punched tomato can and the energy to climb a hoistway. The Calgary and Warfield works now have a combined capacity of 500 tons of nitraprils per day. The product, shipped all over the globe, is important to agricultural recovery.

For the privilege of again visiting Trail and enjoying its stimulating hospitality, I wish to express my appreciation to R. W. Diamond, vice president and general manager of The Consolidated Mining & Smelting Co. of Canada, Ltd., to assistant general manager W. S. Kirkpatrick, and to E. A. G. Colls, manager, of the Chemical and Fertilizers Division. I am indebted to W. D. Burgess for showing me the new sulphuric acid process and to A. F. Snowball for making available an advance copy of his comprehensive paper. And, finally, to Howard W. Bayley and the editors of *Cominco* for sharing so generously their valuable photographic files.

* See "Oxygen-Steam Producer Blast," by R. F. Mitchell, *Canadian Chemistry and Process Industries*, August 1946.

Food Flavor From Beet Sugar

PAUL D. V. MANNING
Vice-President in Charge of Research
International Minerals and Chemical Corp., Chicago, Illinois

INTERNATIONAL STARTS WITH STEFFENS FILTRATE FROM BEET SUGAR; ENDS WITH MONOSODIUM GLUTAMATE TO TICKLE AMERICAN PALATES

MADE in an impure form and used in the Orient for many decades, monosodium glutamate was first placed in commercial production in the United States at the instigation of one of the country's large food processors. It is now being made by three manufacturers who operate four factories. A fourth producer is soon to begin operations.

Three different raw materials are in present use: wheat gluten, corn gluten and Steffens filtrate resulting from the desugaring of beet sugar molasses.

International Minerals & Chemical Corp. is operating two plants, one at Rossford, Ohio, which uses wheat gluten and corn gluten, and a new $3,000,000 factory just south of San Jose, Calif., where concentrated Steffens filtrate from a number of beet sugar factories is used as a raw material.

Problem of Separation

Because of the difficulty of separating glutamic acid from other substances and because of the complexity of the processes involved, it is at present not economically feasible to use, as raw materials, substances in which this amino acid is present in relatively low concentrations. Even corn gluten is a questionable raw material from this standpoint unless markets are available for the large amounts of byproducts.

Production of glutamic acid from the Steffens solution was originally carried out successfully in the United States through a process developed by Dr. A. E. Marshall and his associates for James E. Larrowe. This was done at Rossford, Ohio, the organization being known as the Amino Products Co. In 1942, International Minerals & Chemical Corp. purchased the business. Within a year, the plant was converted to a different process using wheat gluten as raw material. Because of the demand for beet sugar molasses and the decreased production of beet sugar in the central area, wheat gluten became a more advantageous raw material at this location. At the same time plans were made for a new plant in California where the beet sugar industry was increasing and where a larger supply of Steffens filtrate was available and being wasted. This plant was completed in the late spring of 1947 and is now operating satisfactorily, utilizing 100 tons of concentrated Steffens filtrate per day.

MONOSODIUM GLUTAMATE

Here's What It Does For Food

As a savoring agent, monosodium glutamate has some very interesting properties. When pure, it has no flavor. It does have a salty, somewhat sweet taste. But it has the power of flavor accentuation when used with most foods. Delicate flavors of fine foods, partially lost or destroyed in standing after cooking or in processing, are restored or accentuated by this seasoning.—Editor.

In Three Forms

Glutamic acid exists in three forms, due to the fact that it contains an asymmetric carbon atom. They are the *L* (+) or "active" (natural) form, the *D* (−) or "inactive form, and the racemic mixture of the two modifications. The active form is the one occurring naturally. It is the monosodium salt of this form which has the power of flavor accentuation when added to foods. Although it is possible to produce glutamic acid synthetically, the racemic mixture always results. Similarly, the racemic mixture is produced by the hydrolysis of proteins with an alkali. Resolution of the racemic mixture is a very expensive process not commercially feasible at the present time.

Present as Glutamine

Glutamic acid is present in the sugar beet in the form of glutamine. During the processing of the beet sugar juice, the glutamine is changed to the internal anhydride, pyrrolidone carboxylic acid, which remains in the molasses. In desugaring the molasses by the Steffens process, it is first diluted to about 5 to 6 percent sugar, then contacted with freshly burned lime which has been freshly ground. The fresher the lime surfaces and the finer the grinding, the more complete is the sugar removal. With the addition of lime, calcium saccharate is formed. This is insoluble and it is removed by filtration, then returned to the sugar process. The resulting solution contains about 2½ percent dry substance. It has generally been wasted in the past.

Allied With Sugar Plants

By long term cooperative contracts with sugar producers, International has installed large multiple effect evaporators in the sugar plants for concentration of the Steffens filtrate. First it is carbonated with lime kiln gases. Then the precipitated calcium carbonate is removed and the filtrate is concentrated to about 65 percent solids, after which it is run into storage tanks. It is then shipped by tank truck or tank car to the San Jose plant, where it is stored in seven 1,500,000-gal. tanks. Here the concentrates from various sources are blended to make a raw material of fairly uniform quality during each season.

From the storage tanks the concentrate (which has the appearance of molasses) is passed to a weighing tank, then to an Oliver precoat filter. The

Byproduct

In pilot plant at San Jose, Calif. engineers of International Minerals and Chemical Corp. study production of monosodium glutamate from Steffens filtrate

suspended solids are washed to the sewer. If required, the concentration is adjusted by a preliminary evaporation in a single effect calandria evaporator. The liquid is then run into steel hydrolyzing tanks along with a 50 percent solution of caustic soda. Its temperature is carefully controlled as are the pH and time in the hydrolyzers. In this step, the pyrrolidone carboxylic acid is hydrolyzed to glutamic acid.

Separating the Crystals

After cooling, the hydrolysate is acidified with hydrochloric acid and concentrated by means of a forced circulation evaporator. Then the mineral salts are removed by a Bird continuous centrifugal. The pH of filtered solution is carefully adjusted to the isoelectric point of glutamic acid. At this stage, the liquor is chilled by refrigeration and passed into large rubber-lined crystallizers. The time required for crystallizing is approximately 5 to 6 days. During this time the glutamic acid crystals form along with sodium chloride and other solids.

Discharged from the crystallizer, the slurry enters a Dorr thickener. The underflow is passed through a battery of Western States centrifugals, the overflow being passed through plate and frame polishing filter presses along with the filtrate from the centrifugals. The filtrate is then weighed and goes to byproduct operations.

After leaving the centrifugals, the crude glutamic acid is refined. The refined material is made into a solution of monosodium glutamate with caustic soda. It is then concentrated in a single effect boiling pan to the proper density. The solution goes to the La-Feuille crystallizers, where the crystallizing cycle is automatically controlled.

When the cycle is completed, the slurry is discharged from the crystallizers, centrifuged and dried by hot air in a rotary drum dryer. The product is then screened to produce the several sizes desired and it is packaged in fiber containers each holding 200 lb.

Complex Operation

Briefly described the process appears quite simple, but in actual operation, it is quite complex. In the San Jose plant there are nearly 1,500 valves. Corrosion problems are severe. Hydrochloric and glutamic acids are very corrosive and the mixture of the two is extremely so. Only one type of stainless steel has been found even reasonably satisfactory. Rubber lined equipment when properly made has given fair service, but it appears that fabricators of such equipment have something to learn as to the application of rubber to certain kinds of process equipment.

May Racemize

Glutamic acid of the *L* (+) form tends to change to the racemic mixture under certain conditions, not all of which are known at the present time. In solution, also, it reconverts under certain conditions to pyrrolidone carboxylic acid. Since the usefulness of the product depends upon its high purity, the process requires exceedingly careful chemical control. In spite of all the work carried out in many laboratories throughout the country, there is as yet no quick and accurate method for the determination of glutamic acid in any material. It is therefore necessary to use several different methods in control.

Because of the complexity of the process, the opportunities for losses are numerous and these, of course, have immediate effect on yields and production costs.

Automatic Controls

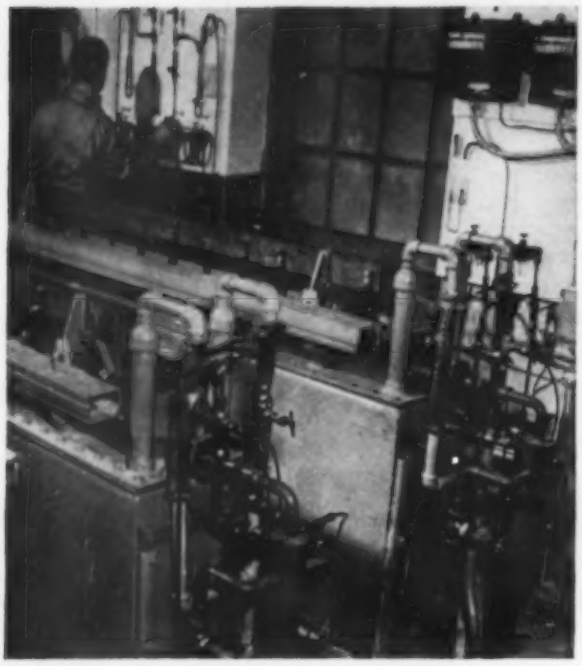
In the San Jose plant, automatic controls are used throughout the entire operation wherever possible. Work is constantly under way in the pilot plant and development laboratory in an effort to improve processes. Operation of the plant is on a "round the clock" basis.

Variations in raw materials usually require some pilot plant work to determine the best full scale operating conditions. When conditions are properly maintained, however, the process is a beautiful example of what precise chemical engineering can do in the food industry.

For More on M.S.G.

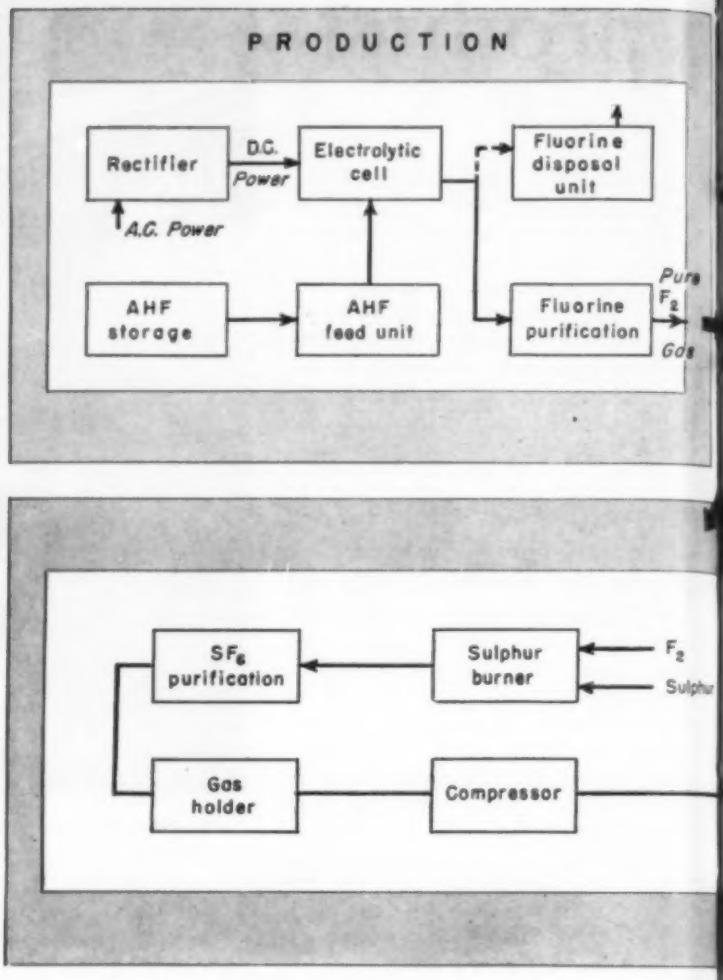
"Chem & Met's" flowsheet on page 136 takes you pictorially through the manufacturing steps from Steffens filtrate to the finished crystals.

Dan Gutleben gives a human touch to the history of M.S.G.'s production in the U. S. You'll meet the personalities in the field in his "From the Log of Experience" on page 223.



FLUORINE—From 60 to 80 lb. of fluorine gas per day is produced by each of Pennsalt's new cells

POWER SUPPLY—Each cell operates continuously at 1,500 to 2,000 amp. supplied by unit rectifiers



FLUORINE P

RICHARD W. PORTER

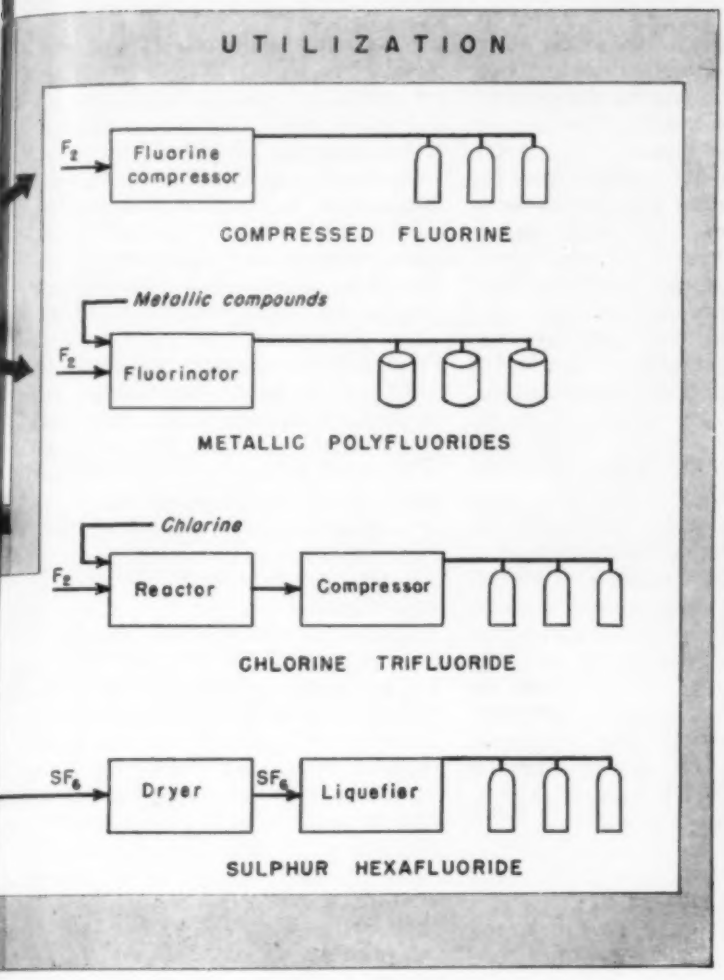
ONE OF THE PIONEERS IN THE FLUORINE I DUST

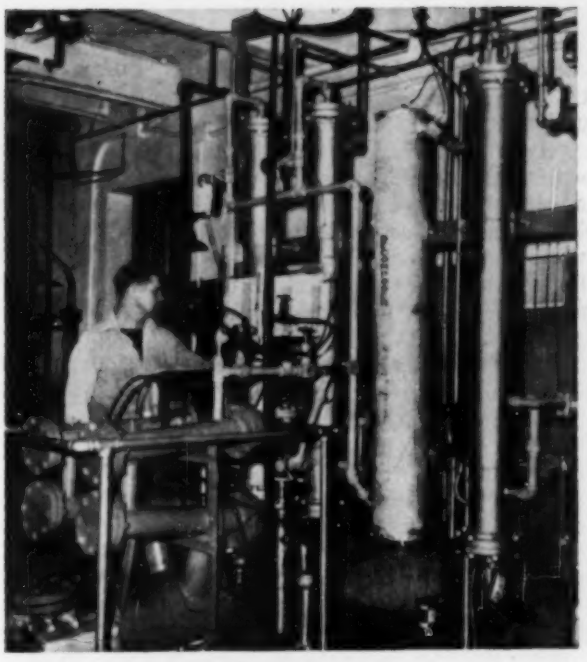
ITS FACILITIES FOR PRODUCTION OF EL MEN

In 1946 the Pennsylvania Salt Mfg. Co. announced the small scale production and sale of compressed elemental fluorine. (*Chem. & Met.*, July 1946 pp. 106-108). For the first time it became possible to store and ship this highly reactive product so that research laboratories and other prospective users could utilize fluorine without having to make it themselves. Since then, increasing demand for fluorine and its compounds has led Pennsalt to build and operate commercial size electrolytic cells and to develop methods for manufacturing such compounds as chlorine trifluoride (ClF_3), metallic polyfluorides and sulphur hexafluoride (SF_6).

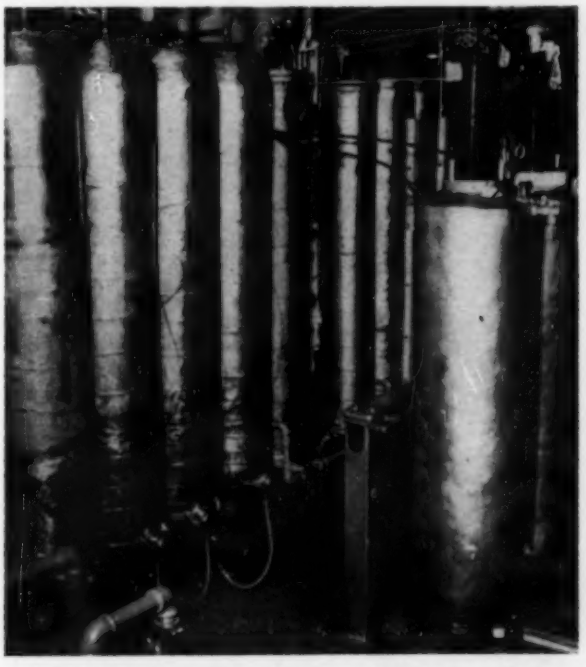
Before the war, fluorine was not available. However, fluorine chemistry is not new since many of its compounds have been produced and used on a large scale for years (see *Chem. & Met.* June 1942, pp 101-103). But with the advent of elemental fluorine, many new possibilities have been uncovered. So far, though, most of the work involving fluorine itself has been in research and development. Work in this field was intensified during the war, the results of which were the subject of a 53 paper symposium at the Chicago ACS meeting in September 1946 (see *Ind. Eng. Chem.*, March 1947, pp. 235-434).

Fluorine itself is a chemical raw material. It can be supplied as compressed F_2 or in the form of compounds such as metallic polyfluorides





SULPHUR HEXAFLUORIDE—Sulphur is burned in an atmosphere of fluorine to form crude SF_6



SCRUBBERS—Crude SF_6 is purified by scrubbing out lower fluorides of sulphur with alkali

PROGRESS

Assistant Editor, *Chemical Engineering*

DUSTRY, PENNSALT RECENTLY EXPANDED MENTAL FLUORINE AND ITS COMPOUNDS

and chlorine trifluoride. These readily make available their flourine content for reaction purposes. Chief advantage of these fluorine carriers is that they are more economical to handle and ship than compressed fluorine, and provide, in many cases, a necessary measure of control of the extreme reactivity of the element itself. Larger amounts of ClF_3 can be shipped with same space required for transporting compressed F_2. For example, a steel cylinder that would hold 4 lb. of F_2 at 400 lb. per sq. in. pressure will hold 100 lb. of Cl_2 (containing 62 lb. of available F_2) at only a slight pressure.

In general, it is not practical to use fluorine for making compounds that can be made with AHF. For instance, sulphur hexafluoride has been known for a long time but without fluorine, it couldn't be manufactured. The Freons and many other compounds that use AHF won't be affected by the availability of fluorine. However, fluorine appears to have greatest possibilities in the field of synthetic organic compounds such as fluorinated hydrocarbons.

First step in expansion was to increase fluorine production. This Pennsalt has done by developing and operating commercial cells to replace the pilot scale cells previously used. Operating at 1,500-2,000 amp. each cell turns out 60-80 lb. of fluorine per day.

The cell is essentially a rectangular vessel of welded steel construction, provided with interdependent and in-

terlocking covers for the anode and cathode sections. From the anode cover is suspended the carbon anode assembly. The gas barrier, a sheet steel skirt welded to the cathode cover, surrounds the upper portion of the anodes and extends below the electrolyte surface to keep separate the products of electrolysis. Beneath the gas barrier the anolyte and catholyte are permitted to mix freely in the cell, no screen diaphragm being necessary. The cell is jacketed for cooling and heating to control electrolyte temperature.

As a safety precaution, pressure relief valves are provided to open at 2-3 lb. per sq.in. ga. This protects against inadvertent admittance of air to the cathode compartment, from the generation of hydrogen in the fluorine compartment because of breakdown of barrier insulation or from excess backpressure in the fluorine compartment forcing fluorine under the barrier and into the cathode compartment with the hydrogen. As a cell auxiliary, a nitrogen flushing arrangement is provided for purging the anode and cathode sections upon starting of initial electrolysis or when the cell is to be dismantled for inspection or repairs. Manometers of the nitrogen bubbling type serve as pressure indicators for both anode and cathode sections and as a means for determining the electrolyte level.

The anode assembly consists of a number of carbon plates attached to special alloy holding shoes arranged in a single row between the two cathode assemblies. This anode assembly is mounted on the anode cover and electrically insulated from it. It is possible to replace a single shoe assembly without disturbing the others. Cathode assemblies are of steel construction and are attached to the cell walls which serve both as supports and electrical contact.

Composition of electrolyte is 40 percent by weight of AHF and 60 percent KF. The cell is initially charged with solid KHF_2 and liquid AHF introduced during application of heat. Resulting electrolyte has a melting point of 72 deg. C. Its composition is maintained substantially constant by continuous feed of AHF to replenish that lost by electrolysis.

During electrolysis the AHF dissociates to form F_2 gas at the anode and H_2 gas at the cathode. The gas barrier prevents intermixing of the products which are discharged continuously under a slight pressure to the purification unit for removal and recovery of contained AHF.

At the operating temperature of 105-110 deg. C., vapor pressure of AHF over the electrolyte is sufficiently high to allow a concentration of about 10 percent by volume in the gaseous product. About 1 volume percent of inert gas is also present. The AHF is removed from the product gases by chemical absorption with sodium fluoride in a packed tower. AHF is regenerated from the resulting $NaHF_2$ by taking the tower off-stream and heating the $NaHF_2$ to 300 deg. C. at which point the combined AHF is vaporized out and collected in a water cooled condensing and receiving system.

Process Variables

Most important process variable is composition of the electrolyte. It is controlled by continuous addition of AHF, the rate being adjusted to cell amperage and being checked at intervals by a level manometer and by chemical analysis. Composition of electrolyte must be closely controlled. If AHF concentration rises, the vapor pressure increases, causing excessive AHF losses. If AHF concentration is allowed to drop, the melting point rises as does the electrical resistance, thus causing an increase in cell voltage. Close temperature control is desirable to attain uniform, efficient operation with minimum power consumption.

Disposal of fluorine must also be considered. During the start-up period of a fluorine cell small quantities of gas must be disposed of. In addition, failure of fluorine consuming equipment or breakdown of the compressor system would require shutting down of the cell, unless a temporary disposal source for cell gas output were available. This may be accomplished by employing a chemical disposal system which discharges only harmless gaseous products to the atmsophere.

Raw materials of high purity are used. Moisture, in particular, causes difficulty because it electrolyzes to form O_2 and F_2O. Raw material specifications which proved satisfactory are:

(1) For KHF_2 the maximum percent impurities are: K_2SiF_6, 0.2; SO_4, 0.1; Cl, 0.05; H_2O, 0.05 percent max. loss in 1 hr. at 100 deg. C.

(2) For AHF the maximum percent impurities are: H_2SiF_6, 0.1; SO_2, 0.06; H_2SO_4, 0.004; H_2O, 0.20.

Fluorine is handled satisfactorily at moderate temperatures by various metals. These include low carbon steel, copper, magnesium, nickel, and Monel. With these materials an adherent fluoride film apparently gives the necessary protection to the base metal. For piping, steel and copper are generally employed, but valve seats and stems, where abrasion occurs, are preferably made of Monel.

As a safety precaution all fluorine compression and packaging apparatus is located behind a steel barrier (½-in. plate). Operation of apparatus is conducted by means of valve extension handles and other remote control devices, operable outside the barrier. Purified fluorine gas is subjected to sufficient heat to decompose trace impurities which might render packaged gas unstable. The fluorine may be compressed mechanically to 30 lb. per sq. in. ga., or to 400 lb. per sq. in. ga. by employing refrigeration and pressure distillation. The latter figure is the maximum permitted under present ICC regulations.

Because of the extreme activity of fluorine, special handling precautions are necessary. All equipment which will be in contact with fluorine must be completely dry. Even small deposits of paint, oil, metal filings, metal oxides, or organic material may ignite and the resulting local heat generation may set fire to piping or equipment. Steel pipe and copper tubing can be used for conveying fluorine, but both of these metals develop a protective fluoride film which may be dislodged by flexure or vibration. When this is not tolerable, or in cases where continued abrasion of metal surfaces can occur (e.g., valve seats), the use of nickel or Monel alloys is preferred. Tapered pipe thread connections or flared tubing fittings are satisfactory. A preferred lubricant for pipe threads is a water-based graphite paste applied only to the external threads with no lubricant on the first two threads. Valves may be of Monel with nickel stems, and may be packed with Teflon. Gages for fluorine under pressure should employ steel Bourdon tubes.

The area around fluorine handling apparatus should be well ventilated and should be cleared of easily combustible material. Whenever fluorine is to be handled under elevated pressure, suitable protective shields should be provided and operation should be designed for remote control. Personal exposure to fluorine should always be avoided, since deep penetrating burns may result, and the effect may be delayed and progressive, as in the case of burns by hydrogen fluoride.

Metallic Polyfluorides

As previously mentioned, an important way to make fluorine available for reactions is by the use of certain

compounds that readily give up their combined fluorine. The first class of compounds to be so utilized are the metallic polyfluorides. These are prepared by reacting the desired metallic compounds with elemental fluorine under specific treatment conditions. Several of these are available from Pennsalt including silver difluoride, Cobalt trifluoride, and anhydrous mercury difluoride. The reactor is equipped with an electrostatic precipitator to remove last traces of metallic salt dusts from off-gas leaving the reactor. This off-gas is vented to proper disposal units adequate to handle specific material involved, such as Cl_2, O_2, CO_2, etc. The Pennsalt unit is equipped with an inert gas flushing system to serve as fluorine diluent where necessary, to remove traces of fluorine from finished products, and to flush out equipment for dismantling or repair operations.

Metallic polyfluorides are packaged in containers made of steel, copper, or aluminum. At present these fluorides are finding their chief application as fluorinating agents for the preparation of many organic fluorine compounds, which are characterized in most cases by extreme inertness.

This class of compounds will make available 10-15 percent fluorine upon heating in contact with organic material. Upon depletion of the available fluorine the metallic compounds can be reactivated and reused innumerable times.

Chlorine Trifluoride

Most significant of the new fluorine compounds is ClF_3. It contains 62 percent fluorine, all of which is available for many reactions. ClF_3 may be stored and shipped as a liquid in lightweight cylinders at the low pressure of 25 lb. per sq. in. ga. in contrast to handling compressed F_2 gas in heavy walled cylinders at pressures up to 400 lb. per sq. in. ga. Chlorine trifluoride is a gas that condenses to a liquid at 113 deg. C. under atmospheric pressure as against −129 deg. C. for fluorine.

Similar to fluorine, chlorine trifluoride was of only academic interest before the war. In Germany, however, a process for making ClF_3 was developed and a somewhat similar method is used in this country. The German method consisted of direct synthesis from fluorine and chlorine. A mixture of the two gases in the correct proportion was heated with a nickel catalyst. Under these conditions the gases combine to form ClF_3.

As a gas chlorine trifluoride is apparently colorless. The pale yellow, mobile liquid solidifies at −83 deg. C. The compound has a somewhat sweet odor differing from that of chlorine or fluorine, and is highly irritating even at low concentrations. Chlorine trifluoride is a vigorous incendiary material, igniting most organic materials on contact, reacting explosively with water or ice, and igniting many metals at elevated temperatures. It reacts as strongly with silicon-containing compounds as does elemental fluorine. Liquid chlorine trifluoride is soluble in all proportions in liquid hydrogen fluoride. The direct action of chlorine trifluoride upon organic compounds may result in the formation of high percentages of carbon tetrafluoride, but under controlled conditions fluorine and chlorine may both be introduced into the organic molecule.

Sulphur Hexafluoride

Although sulphur hexafluoride was first prepared in 1900 and described as a colorless, tasteless, incombustible gas, with an inertness resembling that of nitrogen, manufacture of the gas and application studies awaited the availability of fluoride. The gas has excellent properties for high voltage insulation and has been used for both high voltage electrostatic generators and high voltage transformers. There is some possibility that the gas may also find employment as a special refrigerant, and as a stable high temperature heat transfer gas.

Process steps in Pennsalt's manufacture of SF_6 involve (1) generation of crude SF_6 by burning sulphur in fluorine, (2) purification of crude SF_6 by alkali liquid scrubbing and by passage of the gas through a heated metallic tube, (3) temporary storage of the purified gas, followed by (4) compression, drying, and liquefaction, (5) packaging of liquefied gas.

Fluorine gas is reacted with sulphur in a burner by impingement of the fluorine gas stream onto the surface of molten sulphur. The crude gas reaction products consist largely of SF_6 contaminated with lower fluorides of sulphur. The lower fluorides of sulphur and any AHF which may have escaped the fluorine purification, are scrubbed from the crude SF_6 by contact with alkali liquor circulating through a packed tower. Further purification is effected by passage of the gas through a heated metallic tube, followed by a second alkali scrubbing. Alkali scrubbing liquors are regenerated periolically by re-causticizing with lime and addition of necessary fresh alkali makeup.

Purified, humid SF_6 is stored temporarily in conventional gas holders, sealed with water or brine solution, and held in readiness for the pre-packaging operation of compression, drying and liquefaction. The SF_6 gas is withdrawn from the filled gas holders, compressed and cooled by refrigeration to substantially dehumidify the gas. The dehumidified gas is passed through an absorption drier to remove trace moisture and yield SF_6 having an extremely low dewpoint. For convenience in packaging SF_6 on the present scale of operations, this ultra-dry, purified SF_6 is subjected to further refrigeration to liquefy it under pressure. This liquefied material is drawn from a receiver into evacuated steel cylinders holding 3, 7½ or 100 lb. of SF_6 at 350-400 per sq. in. ga. at room temperature.

Grateful acknowledgment is made to the Pennsylvania Salt Mfg. Co. for permission to publish the information contained in this article. Certain matters described are recognized as being novel and Pennsalt is developing patent protection on these.

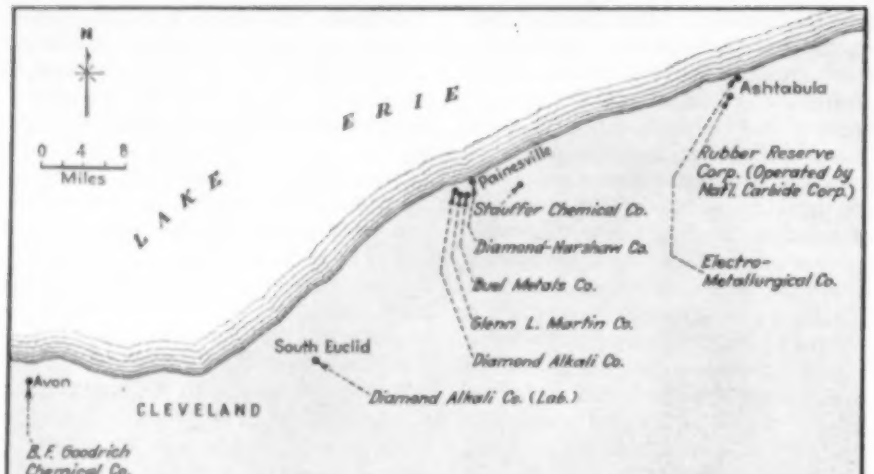
Partial Acetylation Protects Cotton

PROTECTION of cotton fabric and yarn from mildew and other rot can be achieved by converting part of the fiber chemically to cellulose acetate, similar to acetate rayon.

Tests run by the Southern Regional Research Laboratory of the U. S. Department of Agriculture show no other treatment known gives as much resistance against various rotting organisms and heat. The laboratory has developed practical, rapid methods for partially acetylating fabric and yarn, although it has found fabric more difficult to treat uniformly than yarn. Acetylation of 19 percent of the cotton gives moderate rot resistance while up to 30 percent affords extreme resistance. A quick dye method determines the strength of the treatment as untreated cotton takes a blue dye and treated a yellow one.

Processing causes no change in the appearance, feel or strength of cotton, but improves heat and rot resistance. Treated fabric absorbs less moisture therefore swells less when wet. The cotton is dyed as acetate rayon, but cleans easier as it is not damaged by cleaning fluids which dissolve the rayon.

Partial acetylation processes developed at the laboratory already are finding commercial use.

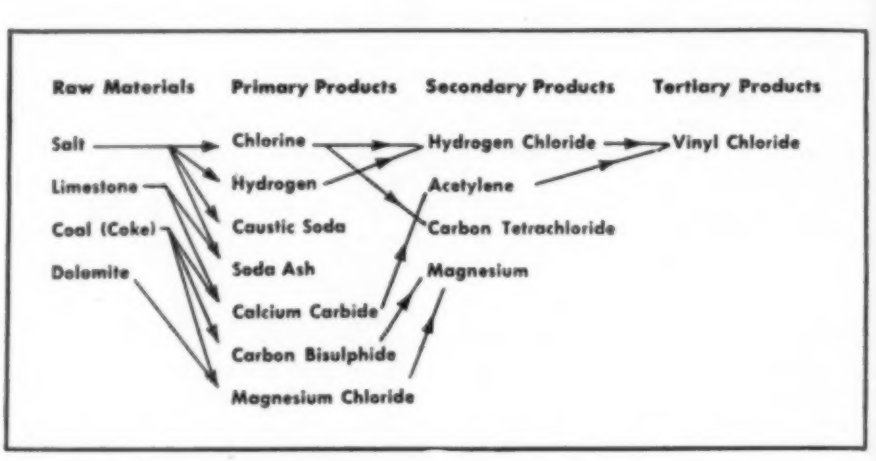


THE AREA

The thirty-mile strip on the south coast of Lake Erie, at one end Ashtabula, at the other Painesville, recently has mushroomed as an electrochemical center. Products already made include soda ash, chlorine, calcium carbide, magnesium, and caustic soda. Area west of Cleveland is also growing. Newest plant there is Goodrich

ITS GROWING COMPLEXITY

With the operation of Martin's new polyvinyl chloride plant, the Ashtabula-Painesville axis enters the third layer of complexity, three steps away from the basic raw materials. More layers will come as the area grows as a center



Electrochemical Axis

R. E. COCHRAN

Editorial Representative, Cleveland, Ohio

THE AREA BETWEEN ASHTABULA AND PAINESVILLE, OHIO, IS GROWING INTO THE NEWEST OF THE UNITED STATES' ELECTROCHEMICAL CENTERS

TYPICALLY, the chemical industry grows by centers where numerous plants go up at one location. One plant feeds the next its raw material. This concentration can become exceedingly complex, particularly in the electrochemical phase of the industry. The electrochemical centers of the past have been Niagara Falls, N. Y., and the Kanawha Valley of West Virginia. More recently Houston, Tex., has grown. The newest, and potentially one of the largest, of such centers is the area between Ashtabula and Painesville, Ohio.

Next month (May 9-12) a regional meeting of the AIChE will be held in Cleveland, Ohio. A more appropriate location would be hard to find since this is the hub of a fast growing chemical industrial area. Chemical engineers who attend this meeting should plan to take advantage of any opportunity to visit plants along the Painesville-Ashtabula axis.

The Ashtabula-Painesville axis already teems with chemical production. Diamond Alkali makes soda ash, caustic soda, chlorine, carbon tetrachloride, magnesium chloride, hydrogen chloride, hydrogen, and cement. Electro Metallurgical and National Carbide produce calcium carbide. Stauffer makes carbon bisulphide. Martin is just beginning production of polyvinyl chloride. Other products of the area include beryllium oxides, magnesium, rayon, ferro-alloys, and pure iron powders.

Development of the area was origi-

nally based on easy availability of much wanted raw materials. Rock salt is present in tremendous quantities some 1,500 ft. below ground. Yields are 150,000 to 250,000 tons per acre at a delivered cost of only 50c. per ton as brine. Limestone and dolomite are readily available by ore boat. Coming from Upper Michigan, the limestone can be had in all grades, including the high calcium stone used for acetylene production. Coal is close-by, power fairly cheap, and water abundant.

Physically the Ashtabula-Painesville axis stretches along the southern coast of Lake Erie for some 30 miles. The area is the bed of a former lake. From 10 to 40 ft. down solid shale is found for building support. The old lake plain extends back from Lake Erie for one to two miles and varies but ten ft. in elevation over its entire length. It is 50 to 60 ft. above the level of Lake Erie, making water supply relatively cheap.

Early Plants

First plant in the area was Diamond Alkali, back in 1912. The plant initially supplied soda ash to a glass plant in Painesville. One of the main users of its soda ash today is the Aluminum Co. of America. The mile-long Diamond plant in Painesville has 2,400 employees. It has its own limestone docks on the Grand River, skirting the plant. One and one-quarter million tons of limestone come over these docks yearly.

Industrial Rayon, like Diamond, is one of the old timers in the area. Its $20,000,000 Painesville plant turns out most of Industrial's 44 million annual pounds of yarn.

Stauffer Chemical Co. constructed a million dollar plant in Painesville several years ago to manufacture carbon bisulphide. The product goes to Diamond for production of carbon tetrachloride, and to Industrial Rayon for viscose rayon production.

Also at the Painesville end of the axis is Clifton Products Co. Main product is beryllium oxide.

World War II played no little part in the development of the Ashtabula-Painesville area as a chemical center. Construction during the war included a magnesium plant, two calcium carbide units, and a ferro-alloy plant.

Defense Plant Corp. spent $16,000,000 building the large magnesium plant one mile east of Painesville. It was operated by Diamond Magnesium Co., a subsidiary of Diamond Alkali. Raw material magnesium chloride was supplied by Diamond Alkali. Dolomite for this operation is readily available in northwestern Ohio. Rated at 36 million pounds per year, this was one of the first magnesium plants to reach full capacity and had the nation's second lowest operating costs. The main plant is now being held in standby condition. A small addition to the plant was sold to Diamond Harshaw, a subsidiary of Diamond Alkali and Harshaw Chemical, for catalyst production.

Carbide Plants

Two of the largest plants in the area produce calcium carbide and ferro-alloys. Both Electro Metallurgical Co., a subsidiary of Union Carbide and Carbon, and National Carbide Corp. had investigated the Ashtabula area prewar. At the war's beginning the area was quickly developed. With Defense Plant Corp. capital, two carbide plants went up. The site was selected because of the availability of electric power. Nearness to the Ashtabula generating station of the Cleveland Illuminating Co. eliminated construction of long transmission lines and sub-stations. The Electromet plant was later expanded to produce ferro-alloys.

Since the war, Electromet purchased the plant which it had operated and is running all nine furnaces, three on carbide and six on ferro-alloys. Power load is 75,000 kw. National Carbide, a subsidiary of Air Reduction, is operating the other plant at full capacity rates with a power consumption of 30,000 kw. The latter plant is operated for the Rubber Reserve Corp.

Combined capacity of these two plants is between 450 and 500 tons of calcium carbide per day. This makes the Ashtabula end of the Ashtabula-Painesville axis second only to Niagara Falls in carbide production.

There are two other plants at the Painesville end of the axis, Glenn L. Martin's polyvinyl chloride plant, and Buel Metals' iron power unit.

Polyvinyl Chloride

Martin's plant is just going into operation at full capacity, although it has been in partial operation since late in 1947. The plant reacts acetylene and hydrogen chloride to produce vinyl chloride monomer. This monomer is then polymerized at the same plant site.

There were real economic advantages to locating a vinyl chloride plant at Painesville. Diamond Alkali produces anhydrous hydrogen chloride by burning chlorine and hydrogen which it produces in its electrolytic cells. This gaseous raw material is then compressed and delivered to Martin by pipeline. Martin buys calcium carbide from only 30 miles away, in Ashtabula, to generate the other raw material, acetylene.

Initial Martin plans were for a 3,000,000 lb. per year pilot plant. However, the rising demand for vinyls of all kinds changed the plans and the first unit is 11,000,000 lb. in annual capacity, with the pilot plant stage being skipped. A second unit is under construction. When this unit comes in, Martin's total vinyl capacity will be 25,000,000 lb. per year. Initially, sales will be of uncompounded resin.

Buel Metals Co. is a wholly owned subsidiary of Butler Brothers. It has built one of the largest electrolytic iron powder plants in the nation at Painesville. The location was picked because of the large demand for high-purity hydrogen, which it could buy from Diamond Alkali.

Cleveland Area

While the area east of Cleveland has been attracting the most attention, the section west of Cleveland is also sharing in the growth.

Goodrich Chemical has purchased 225 acres of land at Avon, 20 miles west of Cleveland. A $750,000 experimental unit was put into operation on the site a few months ago. Plans to construct a major plant at this location were recently announced. The plant, whose products have not been specified, will cost $3,000,000.

Goodrich is also building a main research and development laboratory at Brecksville, about 15 miles south of Cleveland. The research center is estimated to cost $3,000,000.

Other fast growing chemical companies in the immediate Cleveland area include Harshaw Chemical Co., producers of inorganic chemicals, particularly fluorides, nickel anodes, and many types of synthetic crystals. Ferro Enamel Co., also in the area, is one of the world's largest producers of frit and a pioneer in enamel finishes.

Old name chemical and related companies who are adding to the growth of the chemical industy along the lake shore are Standard Oil of Ohio, Glidden, Arco Paint, National Carbon, Brush Beryllium, Du Pont, and Sherwin-Williams.

Already a major chemical center, the area east of Cleveland appears destined to grow in electrochemical output. Whether the new developments in acetylene chemistry will be built on this foundation is an open question.

Production Of Manufactured Ga

FRANK J. JENNY
Consulting Chemical Engineer,
New York, N. Y.

Development of continuous processes for converting coal to gas is one of the important phases in the synthetic fuels research program currently under way in this country. Use of oxygen in such processes has been widely discussed. Equally interesting is the possibility of utilizing gas turbine cycles wherein power, in excess of process requirements, can be made available. Continuous gas manufacturing processes using gas turbines are outlined.

HERE ARE THE PROCESSES:

For Manufactured Gas—

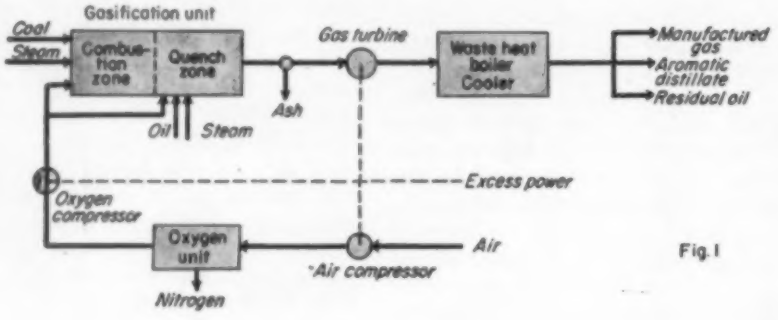


Fig. 1

For Pipeline Gas—

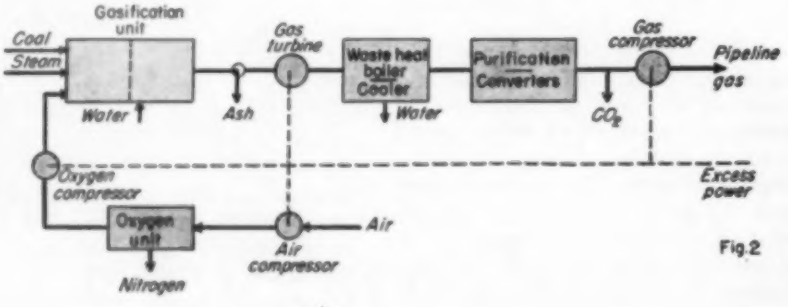


Fig. 2

For Peak-load Gas—

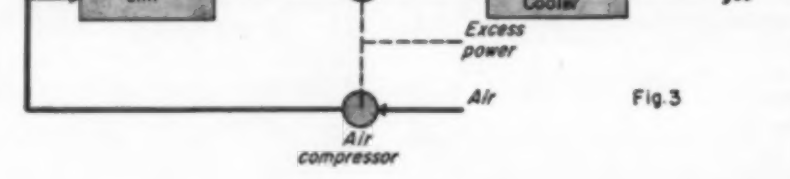


Fig. 3

Table I—Summarized Process Data

Process Variations	I	II (a)	II (b)	III (a)	III (b)
Charge stock					
Coal—tons per day	2,400	2,400	2,400	2,400	2,400
Oil—Bbl. per day	18,600	10,000	10,000	.....	.....
Flowsheet	Fig. 1	Fig. 1	.....	.....	Fig. 2
Power balance	Fig. 4	Fig. 5	.....	Fig. 6	.....
Calorific value of gas—B.t.u. per cu. ft.	530-550	425	670-1080	300-320	500-1000
Thermal output—percent of input					
To gaseous fuel	96.9	75.0	65.1	88.3	70.1
To liquid fuel	.....	21.7	21.7	.....	.....
Steam generation—percent of thermal input	2.6	2.0	11.9	3.2	21.4

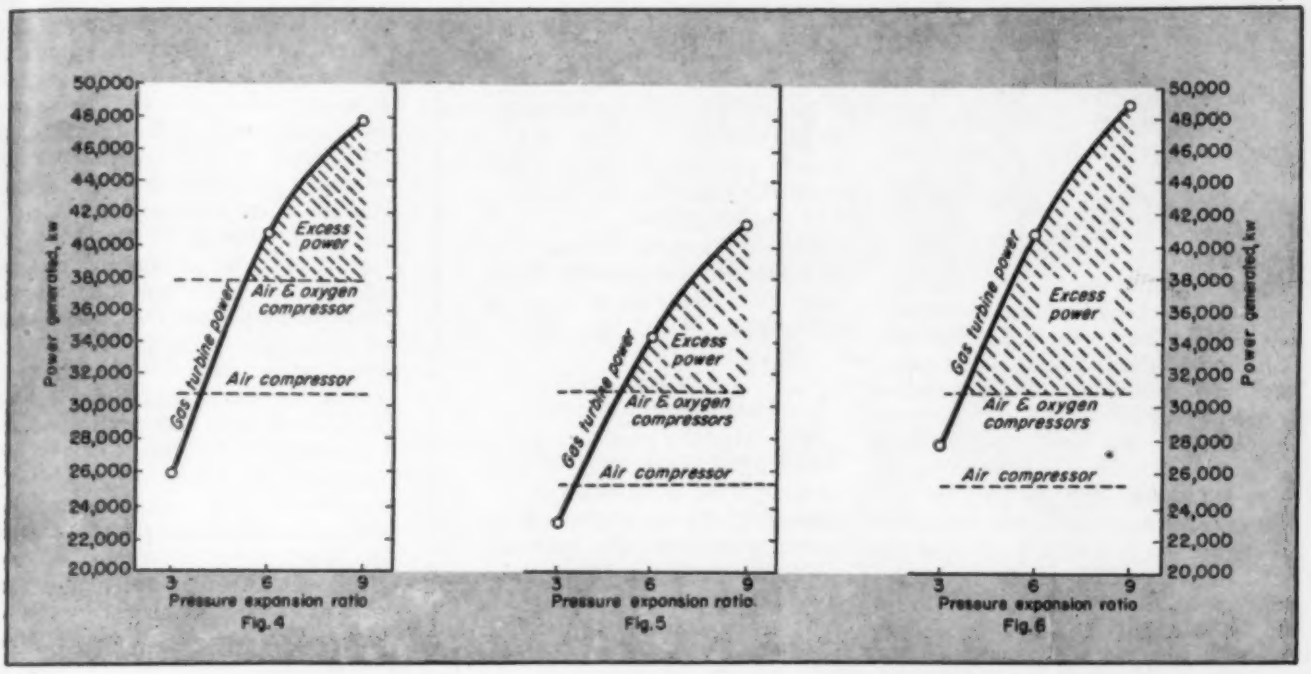
One of the important objectives in the development of the synthetic fuel industry is the conversion of coal and other solid fuels into domestic and industrial fuels such as gasoline, diesel oil, and manufactured gas. This article outlines a continuous process, with a number of variations, for the conversion of solid fuels to manufactured gas. The process design incorporates an oxygen plant which is integrated with a gas turbine cycle.

Before outlining the process for the production of manufactured gas, a number of pertinent comments are offered on recent developments in the gas turbine field.

Gas Turbine Applications

The gas turbine has for a long time been one of the most thought provoking topics in the engineering profession. A great deal of progress has been made in recent years in the development of the gas turbine machine, and in the application of the gas turbine in industry. The applications of the gas turbine in industry were recently reviewed by Carlson (SAE meeting, March 14, 1946) who listed these applications in the following order of importance: (1) Gas turbine propeller drive in aircraft industry. (2) Gas

Gas Using Gas Turbine Cycles



Excess power, over and above process requirements, is available from the gas turbine.

turbine drive for railway service. (3) Gas turbine drive for ship propulsion. (4) Gas turbine central stations.

While this list does not specifically include atomic energy plants in reference to central stations, it is of interest to note that a number of designs have been projected in which a gas turbine has been incorporated as an integral part of the atomic energy power plant, (*Power*, p. 77 Sept. 1947) (Kramer, *Power Plant Eng.*, p. 104, Sept. 1947).

In addition to the foregoing, there have been a number of other applications of the gas turbine. Gas turbines have virtually become a necessity as superchargers in many diesel engine and gas engine applications. In the process industries, an instance where the gas turbine has proved its value has been in the recovery of power from hot flue gases in the Houdry catalytic cracking process (Tucker, *Chem. & Met.*, p. 96, March 1944). It might well be expected that as the process engineer becomes more familiar with the increasing availability of the gas turbine, it will find new and extensive applications in the process industries. It is conceivable, too, that these new applications may, in many ways, result in improvements in the process itself.

In the processes outlined for manufactured gas, an oxygen plant is incorporated to produce a stream of moderately high oxygen purity, e.g. 95 percent, for the partial combustion of solid or liquid fuels. The power generated in the gas turbine is sufficient to supply the power requirements of the oxygen unit proper, and of other auxiliaries in the process. Under certain conditions, it is also found possible to produce excess or byproduct power.

Use of Oxygen

While considerable work has been done on the use of oxygen in gasification processes, the economics of this practice has by no means been established. Nevertheless, the use of oxygen appears to have advantages in certain cases. For instance, elimination of nitrogen is advantageous where pipeline gas or hydrocarbon synthesis gas is produced. Similarly, use of oxygen makes possible certain continuous gasification processes that are not otherwise feasible. However, the economics of oxygen in gasification processes requires considerable study to define its particular place in commercial practice.

The term "manufactured gas" as used in this article is intended to include any gaseous fuel produced from solid or liquid fuels, or produced from combinations of solid and liquid fuels.

Before analyzing the continuous gasification process, a brief description of the process will be outlined. The flowsheet for this process is shown in Fig. 1.

Continuous Gasification

A solid fuel such as bituminous coal in a finely pulverized state, is injected into the gasification unit in admixture with oxygen and steam. The gasification unit operates at superatmospheric pressure, in this particular instance at 150 psi. ga. In the primary or combustion zone of the gasification unit, the combustible elements of the solid fuel react with the oxygen and steam to form a gas which is predominantly CO and H_2.

Immediately following the combustion zone, a liquid fuel is injected into the gas stream. This section of the gasification unit is referred to as the secondary or quench zone. Steam and oxygen may also be admitted to this zone, if desired. Under the influence of the temperatures in the quench zone (in this instance, 1,350 deg. F.), the vaporized liquid fuel will be cracked, that is, converted into light gaseous components and into fractions which are normally liquid under atmospheric conditions.

Following the quench zone, the gases pass through dust separating equipment for the removal of solid particles, and then into the inlet of the gas turbine. Here, the expansion of the gases is considered to take place in one step. No consideration is given to possible intermediate reheat stages in the turbine cycle.

After expansion in the gas turbine, the gas passes through a waste heat boiler, and through a final water cooler. In the water cooler, liquid fractions are condensed. The liquid is separated from the gas in a liquid-gas separator, and the liquid and gas streams may then be further processed for purification of the gas stream and for fractionation of the liquid product into an aromatic distillate and a residual fuel oil.

Although the process as outlined does not necessarily include a further conversion step, the gas fraction may be passed through a suitable converter, if desired, to convert a portion of the CO and H_2 to CH_4 and thus raise the calorific value of the final gas stream to be marketed. Such a converison step may be one similar to that described by Akers and White (AIchE) meeting, Detroit, Nov. 10, 1947).

Process Analysis

The mathematical analysis is, generally speaking, directed toward a fundamental analysis of the thermodynamic calculations of the gas turbine cycle within the present day limitations of the gas turbine itself, and within the limits of the present day knowledge of gasification processes.

A bituminous coal of the analysis designated No. 14, Bureau of Mines Monograph No. 5 (1934) was selected as a basis for calculation. The proximate analysis of this coal is as follows:

	Percent
Moisture	2.2
Volatile matter	36.2
Fixed carbon	57.3
Ash	4.3
Calorific value in B.t.u. per lb.	14,200

In setting up the heat balance for the gasification unit, the following conditions of reactant preheat were selected:

Coal	100 deg. F.
Oxygen	300 deg. F.
Steam (saturated at 150 psi. ga.)	366 deg. F.

The temperature in the combustion zone was set at a maximum of 2,500 deg. F.

With the foregoing conditions, the following additional information may be determined by calculation (per ton of coal):

Gas produced, cu.ft.	85,000
Oxygen required, cu.ft.	20,300
Steam required, lb.	540

It will be noted that the conditions as set forth are predicated on a conversion to a gas stream which is predominantly CO and H_2. The percentage of CO and H_2 in the gas produced is in excess of 90 percent. No allowance is made for the possible direct production of CH_4 such as would be produced in the Lurgi type of operation.

Carburetion

Following the combustion chamber, an oil fraction is sprayed into the gas stream. This section might be considered as the equivalent of the carbureting zone in water gas sets. The operating conditions for this zone may vary over wide limits. For the purpose of illustration, the following conditions were selected (basis, per ton of coal):

Oil added, gal.	326
Oxygen added, cu.ft.	4,560
Steam added, lb.	486
Gas produced, cu.ft.	56,000

The operating temperature in the quench zone was selected to be 1,350 deg. F. In carbureted water gas sets, the volume of oil added which is converted to gaseous components, is a function of the properties of the oil. The lighter oils show a high percentage conversion to gas, whereas the heavier oils produce relatively large amounts of residual oil fractions (McIntosh and Delgass, *American Gas Association Monthly*, p. 21, Jan. 1947). In this first illustration, it has been assumed that one of the lighter oil fractions would be selected which, with the addition of oxygen and steam, would be substantially converted to gaseous components. In a subsequent illustration, an analysis is made in which residual oil fractions are produced.

Following the quench zone, the total gas stream passes through suitable dust separating equipment for the removal of solid particles, such as ash and carbonaceous deposits. The gas stream then passes to the gas turbine machine.

In the gas turbine, the energy which the gas possesses by virtue of its high temperature and pressure is converted into power. This power may be used to satisfy the power requirements of the oxygen unit and other auxiliaries in the process, and under suitable conditions to produce byproduct power.

Gas Turbine Power Balance

From preceding data, the volume of gas available for expansion is 141,000 cu.ft. per ton of coal. On the basis of a unit processing 100 tons per hour of coal (2,400 tons per day), this gas volume is 338,400,000 cu.ft. per day. The gas is available at approximately 150 psi. abs. and 1,350 deg. F.

Selecting an expansion pressure ratio of 6 to 1, and an adiabatic efficiency of 80 percent the power available from expansion is 41,000 kw. The power requirements for air compression in the oxygen unit, using a figure of 12.5 kwh. per 1,000 cu.ft. of oxygen produced is 31,000 kw. (Downs and Rushton, *Chem. Eng. Progress*, p. 12, Jan. 1947). The power required for compression of the oxygen to the gasification unit is approximately 7,000 kw. This gives a total power requirement for compressing the air and oxygen of 38,000 kw., and a net power load, available for other services, of approximately 3,000 kw. Fig. 4 shows the relationship between power generated and power required for various gas expansion ratios.

Discharge temperature of gas leaving the turbine is approximately 975 deg. F., and the discharge pressure 25 psi. abs. The gas passes through a waste heat boiler for the generation of steam required in the process, and then through a gas cooler. Following the cooler, the gas may then pass through gas purification equipment and other conversion steps if so desired.

Process Modifications

It might be noted at this point that a pressure of 150 psi. ga. in the combustion chamber was selected to give a self-contained power balance, as indicated by Fig. 4 at a pressure expansion ratio of 6 to 1. Other process considerations could conceivably result in the selection of a different pressure operating level.

In the above illustration (Case I) the conditions of operation were selected to give a calorific value comparable to that of the conventional carbureted water gas sets, i.e., approximately 550 B.t.u. per cu.ft. The process is not limited to this calorific value, and in the course of subsequent illustrations, calorific values ranging from 300 to values in excess of 1,000 B.t.u. per cu.ft. will be considered.

There are two modifications of the previous process which will be con-

sidered. The first modification (Case II) is based on the exclusion of oxygen in the quench zone. The second modification (Case III) will be the elimination of oil quench completely.

In the first modified process (Case II i.e., the exclusion of oxygen directly admitted to the quench zone) the oil fraction is thermally cracked to a gas of high calorific value, an aromatic distillate, and a residual fuel oil. The properties of the oil used are, for example, equivalent to a 35 deg. East Texas gas-oil. (See flowsheet Fig. 1.)

Generation of gas from solid fuel in the combustion zone remains unchanged. Likewise, the temperature in the quench zone is again set at 1,350 deg. F. However, the volume of oil added is appreciably less than before. The following figures (per ton of coal) apply to the quench zone.

Oil added, gal.	175
Gas produced, cu.ft.....	8,360
Cracked liquid fuel, gal.	81.5

Total volume of gas available for expansion now amounts to 222,000,000 cu.ft. per day for a 2,400 ton per day unit. As shown in Fig. 5, the power available from gas expansion at an expansion pressure ratio of 6 to 1 is again in excess of the power requirements of the air and oxygen compressors.

Calorific value of the gas produced (Case IIa) is approximately 425 B.t.u. per cu.ft. However, this value may be increased (Case IIb) to a value in excess of 1,000 by the addition of a further conversion step based on the following reaction:

$$2\,CO + 2\,H_2 \rightarrow CH_4 + CO_2$$

The high calorific value necessarily requires the removal of CO_2 by use of a suitable scrubbing agent. Thus, if 95 percent of the $CO + H_2$ is converted to CH_4 and CO_2 and 99 percent of the CO_2 is removed by the use of a suitable solvent, the calorific value of the purified gas stream will be approximately 1,080 B.t.u. per cu.ft.

Elimination of Oil Quench

In the second modified process (Case III), the use of oil is eliminated completely, and the spread between the minimum gasification temperature and maximum inlet temperature to the gas turbine is bridged by quenching with water or steam. (See flowsheet, Fig. 2.)

Assuming (Case IIIa) that liquid water at 100 deg. F. is used as the quench medium, the quantity of water quench required is approximately 1,260 lb. per ton of coal for a drop in temperature from 2,500 deg. F. to 1,350 deg. F. The total volume of gas available for expansion under these conditions for a 2,400 ton per day unit is 266,000,000 cu.ft. per day. Power production and power requirement figures are plotted in Fig. 6.

Gas produced has a calorific value of approximately 300 B.t.u. per cu.ft. As in the previous illustration, the calorific value of the gas may be increased to approximately 1,000 B.t.u. per cu.ft. by conversion of CO and H_2 to CH_4 and CO_2, with subsequent removal of CO_2 by use of a suitable scrubbing agent (Case IIIb).

Recompression to Pipeline Pressures

In the preceding illustration (Case IIIb), it is of interest to note the power requirements of compressing the 1,000 B.t.u. gas to pipeline pressures. Reconsidering the conversion reaction

$$2\,CO + 2\,H_2 \rightarrow CH_4 + CO_2$$

it will be noted that for every four volumes of gas available for expansion, only one volume of gas must be compressed to pipeline pressures. Likewise because of the high temperatures in the expansion step compared to atmospheric temperatures in the compression step, there is a further temperature advantage of approximately 2½ to 1.

Accordingly, the power required for compressing the 1,000 B.t.u. gas is only a fraction of the power available from expansion. Referring to Fig. 6, the indicated excess power available at an expansion ratio of 6 to 1, is sufficient to recompress the 1,000 B.t.u. gas to a pipeline pressure of 350 psi. ga. with allowances made for suitable pressure losses in the system.

Data given in the preceding paragraphs are summarized in Table I. This table also indicates the thermal efficiency of the process and its various alternates.

Thermal output, expressed as a percent of input, was determined by subtracting the heat lost to cooling water from the heat input in the coal and oil fractions. Cooling water losses include the sensible heat duty in cooling the product streams following the waste heat boiler, and also the heat of compression of air and oxygen.

Losses due to carbon in the ash were not included since these losses will vary appreciably, depending upon the ash content of the solid fuel and the efficiency of burning. For Case I, with 50 percent carbon on ash, the estimated thermal loss is less than 1 percent.

In Case IIb and Case IIIb, wherein CO and H_2 are quantitatively converted to CH_4 gas, the thermal output in the gaseous product is reduced by the value of the exothermic heat of reaction. Since this heat would be recovered by the generation of steam, a corresponding credit is given to steam generation. If CO_2 removal step is included in the process, part of this quantity of steam would be utilized to satisfy process requirements.

Process Using Atmospheric Air

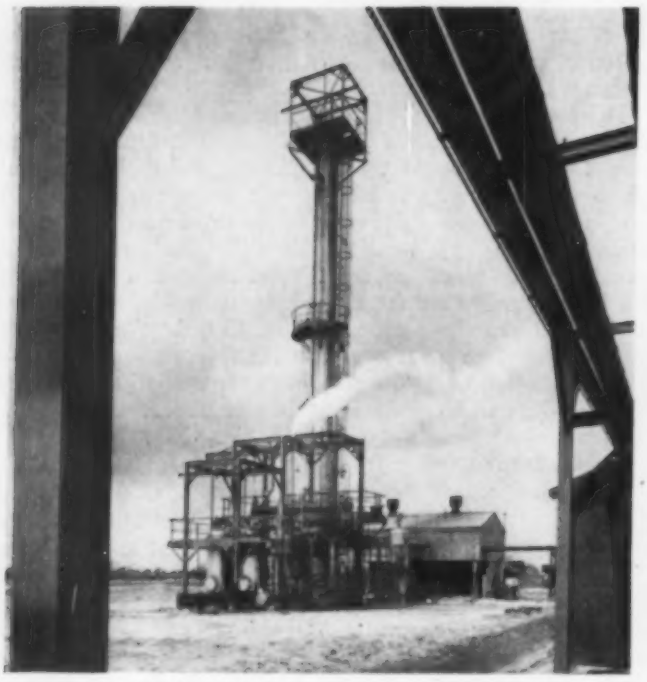
In all preceding illustrations, an oxygen plant was included as an integral part of the process. A number of practical applications might be considered in which atmospheric air is substituted for the high purity oxygen stream. Such a process is illustrated in Fig. 3.

In this process, a solid or liquid fuel is gasified in the gasification unit with air at a pressure, for example, of 50 psi. ga. The gases leaving the combustion zone of the gasification unit may be quenched with an oil stream, as in previous illustrations, and again the total gas stream expanded through a turbine for the generation of process power and by-product power.

An alternative to the oil quench would be the injection of LPG (liquefied petroleum gas). With LPG, the residence time in the quench zone would be reduced to a minimum to prevent thermal cracking reactions. This process would be a substitute for propane-air sets which are used primarily to satisfy peak-load gas requirements. When not in use for producing gas, the turbine set could be used for the generation of power.

Summary

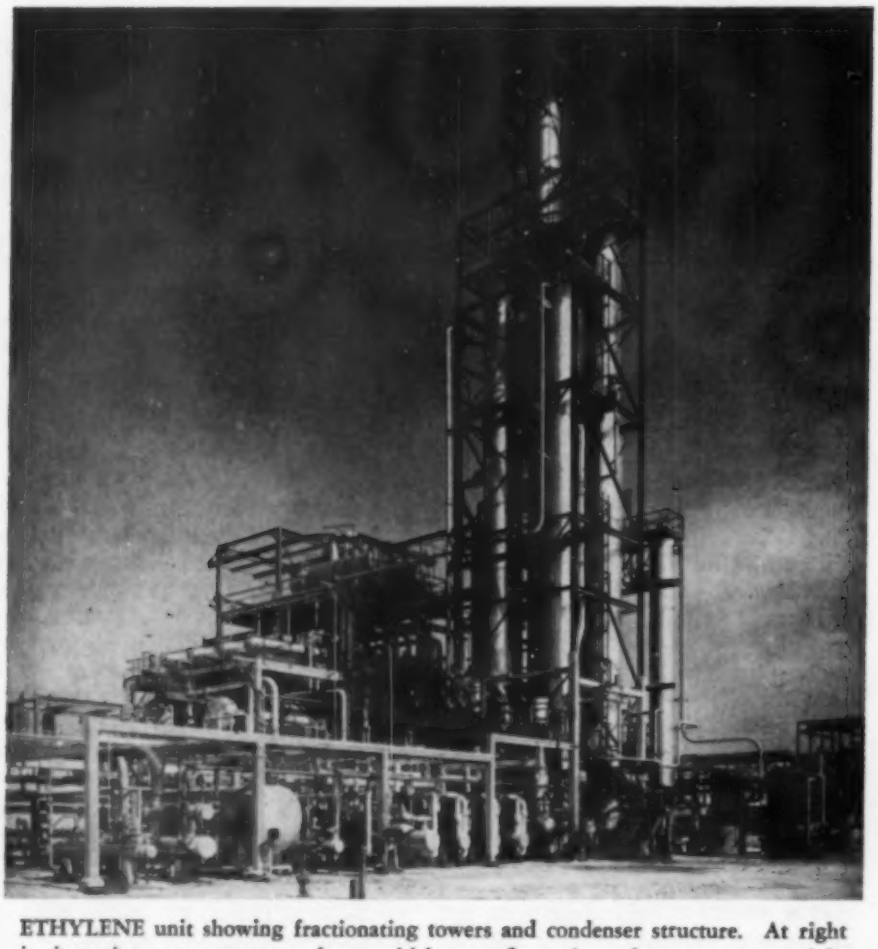
A process has been outlined for the continuous production of manufactured gas from solid and liquid fuels. The process incorporates a gas turbine cycle which generates the power required for the air and oxygen compressors of the oxygen unit, and in addition may also generate by-product power. Calorific values of gas are considered, ranging from 300 to 1,000 B.t.u. per cu. ft., and it is shown that the high B.t.u. gas can be compressed to pipeline pressures with the unit still in power balance. Consideration is also given to a simple cycle using atmospheric air, again with a gas turbine, and using liquefied petroleum gas for enrichment.



ETHYLENE DICHLORIDE fractionating tower and purification unit with dryers and exchanger structure in foreground

CHLORINE storage tanks showing double relief valve system with geared interlocking valves next to the tank

Jefferson Chemical Ente

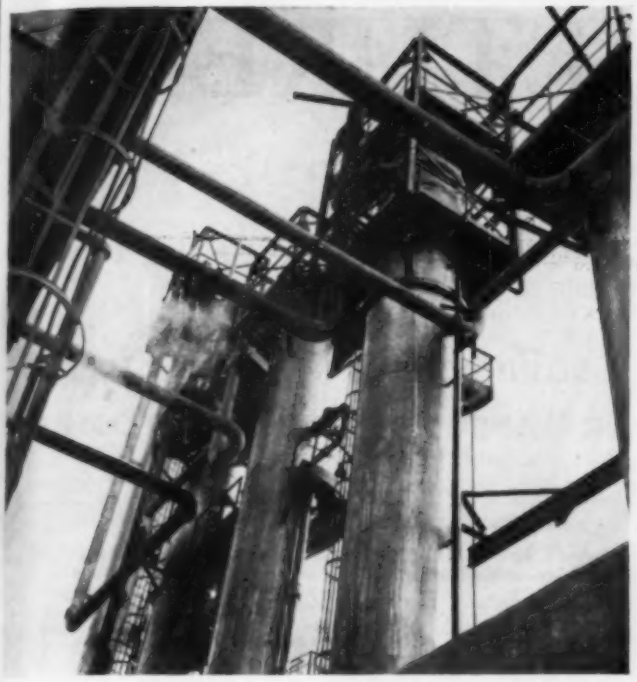


ETHYLENE unit showing fractionating towers and condenser structure. At right is incoming gas separator from which gas flows into first tower on right

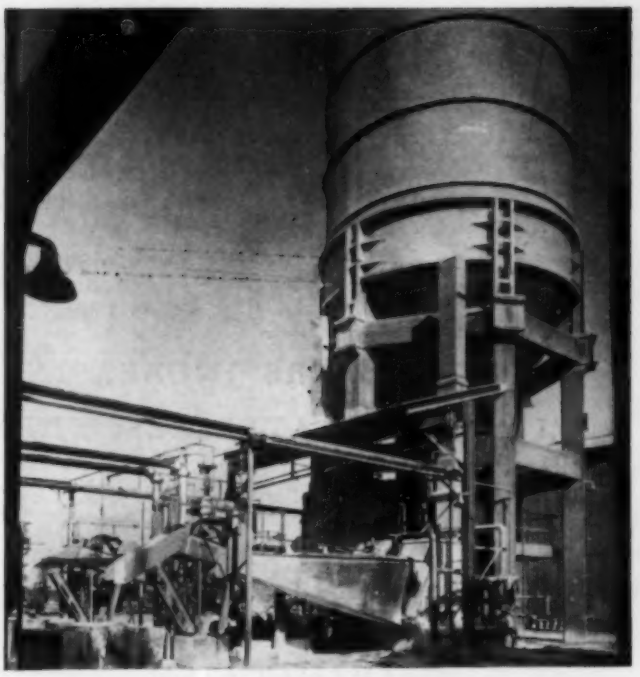
NEAR Port Neches, Tex., Jefferson Chemical Co. has begun the manufacture of ethylene oxide and ethylene glycol from petroleum refinery gases carried approximately five miles by a 6 to 8-in. pipeline from the Port Arthur refinery of the Texas Co., joint owner with American Cyanamid, of the new company. This is only the start of a long-term construction program which already includes the production of ethylene dichloride, ethylene polyglycols, aromatic distillate and hydrocarbon polymers as co-products of the ethylene oxide and ethylene glycol operations.

As it stands today the plant occupies only a small portion of Jefferson's 1,100 acre plot. The fact that this large tract has been acquired is an indication of years of growth to come. Construction of the plant in the neighborhood of the refinery of the Texas Co. also suggests that the refinery may go further into the chemical field with Jefferson as a convenient and expanding consumer of hydrocarbon raw materials. Adjacent to Jefferson, American Cyanamid owns about 900 acres but so far has not announced its plans for use of the property. The large butadiene plant of Neches Butane Products Co. is another member of the nucleus of chemical manufacturers in the Port Neches area.

Principal processing chemicals used



ETHYLENE OXIDE and ethylene glycol unit fractionating towers. Note access platforms, tray removal trolley rails



QUICKLIME silo and lime slakers on ethylene oxide and ethylene glycol unit. Screw conveyor takes lime to top

Petrochemicals Field

J. V. HIGHTOWER
Southwestern Editor, *Chemical Engineering*

in the Jefferson plant are lime and chlorine. Chlorine is received in tank cars at an isolated unloading rack and is there discharged by air dried with activated bauxite. As a precaution against losses of chlorine into the atmosphere at the unloading area a "sniff" system is used. When the chlorine lines have to be opened at any point the gas is discharged into a vacuum header which permits the recovery of the gas for subsequent use.

Interesting features embodied in the design of the plant includes attention which has been given to the compressor area. Special care has been exercised to minimize vibrations which might impair the accurate functioning of indicating, recording and controlling instruments. Compressors are anchored on a concrete mat so designed that the mass of the compressors plus the mat has a different natural frequency from the speed of the compressors. Also, the foundation of the compressor house is separate from the mat.

Activated bauxite is used in the plant to furnish dry air required for unloading of chlorine and other purposes. A blanket of dry air is maintained over the surface of some of the finished products in storage which could deteriorate in the presence of moisture. Ethylene oxide is stored in pressure spheres. Storage for all other products consists of standard cone-roof tanks. No difficult problems of storage, such as corrosion, are expected to develop.

Tube Removal

Arrangement exists for easy removal of tubes in the heaters of the unit for manufacturing ethylene from the desulphurized refinery gases from the Texas Co. refinery. This unit has two sections of gas fired heaters, each section consisting of four tubular heaters. In each of the eight individual heaters is a center group of tubes removable as a unit. This entire assembly can be removed for repairs or inspection by unbolting a section of removable steel sheathing and lifting out the assembly by a hoist attached to an A-frame and trolley beam arrangement. The A-frame can be moved through the entire length of the two main sections of heaters to service the whole heating unit.

To permit the rapid discharge of combustible gases and liquids from the process units, all such units are tied at one or more points into a 14-in. line leading to a 175-ft., 18-in. dia. flare stack on the outskirts of the plant. The 14-in. line enters an 8x30-ft. horizontal steel drum and discharges beneath the surface of water contained at one end of the drum by a weir. An outlet line runs from the top of the drum to the base of the flare stack, which is so designed that the probable velocity of gases entering it is greater than the calculated rate of flame propagation.

With respect to water, the plant draws its supply from the upper reaches of the Neches river through a canal which feeds into a 20-in. line leading to an 18 million gallon reservoir. Water is taken from the reservoir through two 18-in. lines, one of these servicing the fire system and the other furnishing water for boilers, process units and other purposes. All water used in the plant is treated with soda ash, clay, alum and chlorine, and that used in the boilers is in addition given a zeolite treatment. Induced draft cooling towers are used. Electric power is obtained from a substation of Gulf States Utilities Co. at 33,000 v. and is reduced at the plant by the utility company to 2,400 v.

Design and construction of the ethylene unit was handled by the Lummus Co. E. B. Badger & Sons Co. and Jefferson Chemical Co. collaborated on the process design of the equipment for ethylene oxide and ethylene glycol. Badger made the detailed plans and erected the equipment. The Jefferson engineering department designed the general facilities. The boilers are of Foster-Wheeler Corp. design.

AGRICULTURE

PHILIP H. GROGGINS
Chemical Engineer

Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
United States Department of Agriculture

WHILE FARMERS INCREASINGLY SUPPLY CHEMICAL INDUSTRY WITH RAW MATERIALS, THEY ARE ALSO ITS BEST CUSTOMERS

Producer of Chemicals

From crops and farm wastes chemical industry turns out a bewildering array of products. Among its recent feats are solvent extraction of vegetable oils, development of protein fibers and recovery of monosodium glutamate from sugar beets and wheat.

Table I. Estimated Quantity and Wholesale Value of Major Agricultural Products and Byproducts Used by Industry in 1945

Farm Products	Estimated Quantity	Estimated Value
Oils and Fats		
Primary	2,869,381,000 lb.	$316,470,000
Secondary	639,496,000 lb.	63,947,000
Glycerol	180,000,000 lb.	36,000,000
Naval Stores: Gum and Wood		
Turpentine	510,000 (50 gal.) bbl.	5,700,000
Rosin	1,541,000 (510 lb.) drums	48,080,000
Grains		
Corn wet milling	111,940,000 bu.	223,000,000
Distillery (1941)[1]	30,600,000 bu.	30,600,000
Tobacco		
Nicotine and salts	1,200,000 lb	2,500,000
Dairy Industry		
Lactic acid	6,000,000 lb.	1,200,000
Casein	65,000,000 lb.	15,600,000
Lactose	19,000,000 lb.	4,500,000
Cotton-Wood Pulp		
Cellulose derivatives	113,080,000 lb.	28,871,000
Sugar		
Molasses (1941)	221,000,000 gal.	34,000,000
Bagasse	600,000 tons	2,400,000
Miscellaneous Byproducts		
Furfural	50,000,000 lb.	5,000,000
Lecithin	6,000,000 lb.	1,200,000
Sodium glutamate	5,000,000 lb.	6,000,000
Tanning materials	120,000 tons extract	12,000,000
Total		$1,037,068,000

[1] Total production, 8,770 million pounds.
[2] Arbitrary value at $1.00 per bushel.

AGRICULTURE is both a producer and consumer of chemicals. Man must always depend on agriculture not only for foodstuffs but also for many chemicals. While agriculture has always been an important supplier of chemicals, recent advances have increased the use of such chemical constituents of crops as carbohydrates, proteins and fats as raw materials in the synthetic organic industry. This is a rising trend. To do its job, agriculture likewise consumes a wide variety of chemicals, both organic and inorganic. Since 1900 agriculture has become a major consumer of chemicals. Farmers have learned that chemicals are good crop insurance.

Chemical technology has increased the importance of agricultural raw materials in industry. Enormous sums are invested in plants converting farm crops and byproducts into important articles of commerce through chemical, biochemical, enzymatic and other processes.

Petrochemical Threaten

But the preeminent position of agriculture as a supplier of chemicals is now threatened by the petrochemical industry. Recent developments at home and abroad involving the synthesis of a wide range of organic alcohols and acids, synthetic fibers, synthetic glycerol, fatty acids and fatty alcohols are examples of this trend. This new competition will stabilize the economics of many chemical operations currently geared to the utilization or conversion of farm crops. Spokesmen for agriculture cannot halt these technological developments. They must accept and evaluate them. Stable and reasonable prices for certain farm crops are prerequisites for expanded operations. Consequently, competition from petrochemicals may prove beneficial in some instances.

Major contributions of agriculture as a supplier of raw materials to chemical industry are set forth in Table I. It will be noted that the 1945 value of the indicated materials is about $1 billion. It is apparent that this is a relatively small percentage of the total value of farm crops which supply food, clothing and shelter. In 1943 total value of farm crops was about $15 billion (see Table VII). If the 1945 value of the grains and other agricultural products that went into wartime production of industrial alcohols were used, the sum would be much larger.

By way of comparison, total value of organic chemicals for 1945 estimated by the Manufacturing Chemists Association was only $1.5 billion. The same source indicates the 1944 value of rayon and allied products at $488-

This article is based on an address to the Chemical Market Research Association at its meeting on Jan. 22, 1948, in Washington, D. C.

Consumer of Chemicals

Farmers are chemical industry's best customers. They need fertilizers, insecticides and fungicides. In this crop year they will use more than 800,000 short tons of commercial nitrogen and one-third of the sulphuric acid made in the United States.

Table II. Estimates of Fertilizer Used on Principal Crops[1]

Crop	Percent of Total Consumption 1929	1938	1942	1946
Corn	20.7	21.6	22.0	21.3
Small grains	13.8	14.3	14.1	13.9
Vegetables	5.3	4.3	8.9	10.5
Cotton	28.0	19.3	14.6	9.8
Potatoes	8.5	7.4	7.1	6.6
Tobacco	6.8	6.7	5.3	6.6
Hay	2.1	4.1	7.1	6.0
Fruits and nuts	4.3	4.3	6.7	6.3
Pasture	—	2.1	5.8	5.3
Sweet potatoes	1.4	1.8	1.3	1.0
Other crops	9.1	13.9	6.9	12.7
Total	100.0	100.0	100.0	100.0
Tons consumed (Thousands)	5,500	7,316	10,007	14,892

[1]According to Engle and Makela, *Fertilizer Review*, Dec. 1947.

Table III. Estimated Consumption of Economic Poisons in 1947[1]

Materials	Pounds
Calcium arsenate	35,000,000
Lead arsenate	28,000,000
Copper chemicals (sulphate basis)	105,000,000
Paris green	1,000,000
Rotenone	8,000,000
Pyrethrum	5,000,000
Sodium fluoride	4,000,000
Sodium fluosilicate	3,000,000
Thiocyanates	7,500,000
Formaldehyde	1,750,000
DDT and homologs	25,000,000
Benzene hexachloride insecticide	5,000,000
2,4-Dichlorophenoxyacetic acid	5,000,000
Diphenylamine	200,000
Phenothiazine	4,000,000
Carbon bisulphide	5,000,000
Carbon tetrachloride	6,000,000
Ethylene dichloride	6,000,000
Total	254,450,000

[1]Chemical Div., Bur. Foreign and Domestic Commerce.

Table IV. U.S. Fertilizer Consumption[1]

	1935-39 Five-Year Average Consumption (Tons)	1946-47 Approximate Distribution (Tons)	Estimated 1947-48 Supply (Tons)	Estimated Increase From 1935-39 Average to 1947-48 Est. (Tons and Percent)	From 1946-47 to 1947-48 Est.
Nitrogen: Tons of N	371,236	785,000	850,000	478,764 129%	65,000 8%
Phosphoric acid: Tons of P_2O_5	719,538	1,700,000	1,850,000	1,130,462 157%	150,000 9%
Potash: Tons of K_2O	375,076	859,000	884,000	508,924 136%	25,000 3%
Total for three major nutrients	1,465,850	3,344,000	3,584,000	2,118,150 144%	240,000 7%
Total tonnage materials	8,000,000	15,800,000	17,000,000	–	–

[1]Including Hawaii and Puerto Rico

Table V. U.S. Agricultural Consumption of Commercial Nitrogen by Kind of Material[1]

(Short tons of nitrogen)

	1910	1937	1941	1943-44	1947-48[2]
Sulphate of ammonia	27,880	140,760	138,248	175,730	185,000
Ammonium nitrate	–	–	–	101,311	175,000
Ammoniating solutions	–	39,170	65,300	135,986	250,000
Nitrate of soda	35,030	128,150	140,400	150,145	130,000
Nitrate of soda-potash	–	8,838	5,900	–	–
Calcium nitrate	–	6,368	150	9,938	1,600
Calcium cyanamide	540	24,725	25,700	19,382	15,600
Ammonium phosphates	–	7,800	6,200	11,033	22,600
Urea and calurea	–	1,952	14,400	9,948	7,300
Other chemical nitrogenous	70	7,233	3,700	–	–
Organics	78,142	46,580	51,410	30,000	30,000
All materials	141,662	411,576	451,308	643,673	827,300

[1]According to National Fertilizer Ass'n. and U.S. Dept. of Agr. data and estimates. [2]Estimated supply includes imports.

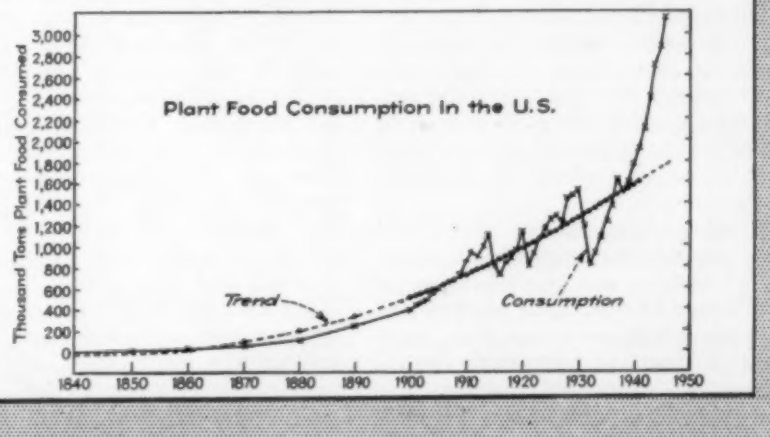


Fig. 1—Plant food consumption in the United States from 1840 to 1946. Points on trend curve were calculated from the equation $y = 0.1728x^2 - 1.248x - 34.855$ according to Mehring and Clark)

million, plastics and synthetic resins at $306 million, paints and varnishes at $700 million and acyclic synthetics at $791 million.

A detailed and integrated agronomic, economic, technologic and market study of each major farm crop entering manufacturing would be valuable to those in chemical market research. Such an organized analysis is contemplated but not yet available. A fund of information is obtainable, however, in Senate Document No. 65, 76th Congress, 1st session. This served as a basis for research now carried out in the four Regional Research Laboratories of the Bureau of Agricultural and Industrial Chemistry, U.S.D.A. Information is also contained in the comprehensive commodity reports prepared as guides for research sponsored by the newly created Research and Marketing Administration, U.S.D.A.

Soybean, youngest major crop, has

risen steadily in industrial importance. In 1944 soybean oil production topped that of cottonseed oil, and in 1946 it took the lead as a source of edible oils.

From soybeans, which contain about 40 percent protein and 20 percent fat, come edible oil, semi-drying oils and lecithin. Research concentrates on quality improvement of these constituents. Oilseed meal, containing about 50 percent protein, goes into adhesives and plastics. Prewar price of solvent-extracted soybean meal was $40 a ton. At such a price, industry will seek a greater profit by turning the meal into protein fibers, amino acids and plastics instead of selling it as a feedstuff, now its major use.

Corn and Wheat

In quantity and value of derived products, corn leads all chemurgic crops. Beverage alcohol manufacture normally consumes about 20 million bushels of this grain. In 1945 the wet milling industry used 111,940,000 bu. of corn (about 4 percent of the crop) and produced products valued at $223 million. This compares with the 1935 grind of 58,319,000 bu. having a product value of $103,600,000. Favorable economic conditions and continuing research insure corn's top position as a chemurgic material.

Markets for primary and derived corn products, starches, dextrins, oil, zein and sugars, are well established and steadily developing. Aside from more efficient utilization of gluten feed and steep water, the greatest prospects for expansion are in the production of corn sugar and glucose sirups. In 1945 and 1946 there were produced respectively 744,000 and 749,000 tons (dry basis) of corn sirup and 300,000 and 270,000 tons of corn sugar. Contribution of the wet milling industry to total United States supply of sweeteners for these years was 14.11 and 14.20 percent. The wet milling industry achieved these production records despite the war and without government financial aid. During these same two years the government spent about $100 million to subsidize production of cane and beet sugars on the mainland and in insular possessions.

Confectionery, bakery, dairy and beverage industries appreciate the merits of dextrose and sucrose, alone or combined. They are able in their production operations to use these competitive sugars to advantage. Institutional and household markets have not yet appreciably been invaded. These fields offer enormous possibilities. Because of these considerations, the future looks bright for the wet milling industry and the industrial utilization of corn.

Chemurgic use of wheat is still in its infancy in this country. Such operations have been carried out successfully for many years in Australia, where wheat is cheaper than in the United States, and in the Orient. Wheat contains about 72.5 percent carbohydrate and 13.0 percent protein from which monosodium glutamate is derived. To permit profitable operations, the returns from the byproduct gluten, recovered or converted starch and sodium glutamate must exceed the cost of wheat plus processing costs. A market for about 8 million pounds of sodium glutamate, derived from sugar beets and wheat, has developed within ten years. United States wheat production in recent years has been almost twice our normal consumption. Thus chemurgic possibilities of wheat and markets for its derived products merit exploration.

Turpentine and Rosin

Naval stores are finding new markets to offset their declining use in paints and varnishes. A few years ago turpentine, with white lead and linseed oil, went into most protective coatings. Within the past five years, however, turpentine consumed by the paint and varnish industry has dropped from 63,849 to 17,828 bbl. Use of rosin in coatings has also shrunk appreciably. But turpentine entering manufacture of chemicals and pharmaceuticals has climbed from 55,625 to 107,078 bbl. during the past five years. During this period a new outlet for 16,945 bbl. of turpentine was added to an average market of 250,000 drums of rosin for manufacture of ester gums and synthetic resins.

In 1945-46 there were produced 164,090 bbl. of turpentine and 1,219,234 drums of rosin. These figures closely approximate average wartime production. To maintain this output, research will have to develop new products and more remunerative outlets to replace markets which have been or may be lost to petroleum chemicals. Cheap labor, once an important item in naval stores production, probably will not return soon. Hence chemistry must provide new processes and uses.

Solvent extraction is the outstanding recent advance in production of oils and protein meals from cottonseed, peanuts and soybeans. In the immediate future solvent extraction processes will be improved. The derived proteins will be used for industrial purposes in the future, especially fibers.

Research has improved wet and dry tensile strength of regenerated fibers from casein, soybeans, peanuts and corn proteins. Techniques which will build up the protein fiber industry are: (1) use of hardening agents; (2) use of stretching agents; (3) chemical modification of fibers; (4) use of regenerated fibers together with natural or other synthetic fibers; and (5) extrusion of protein suspensions onto the surface of cotton or other fibers having high wet and dry tensile strength.

Industrial production of peanut, soybean and corn protein fibers may come this year. In any event, oilseed proteins, including cottonseed and flaxseed, are slated for an important role in the future textile industry of America.

Chemurgy has other case histories of crops and agricultural byproducts put to industrial use. Some processes, such as the production of nylon from corncobs, hold promise for profitable future activities. Others, in the light of potential competition from stored hydrocarbons, could hardly be recommended for venture capital. In general it would be wise to establish as a major objective of chemurgic research, not involving national welfare, the development of products which cannot readily be produced in volume from natural gas, petroleum and coal through the medium of organic synthesis. This competition from gradually diminishing supplies of hydrocarbon reserves should, however, be accepted as a challenge by those now directing or prosecuting chemurgic research with reproducible agricultural products.

Agriculture the Customer

Agriculture is the largest consumer of chemicals. Wartime tonnage of chemicals required for farming and food processing exceeded chemical requirements of the armed forces.

The war emphasized and accelerated the changes in the agricultural and economic environment that are creating this enormous demand by farmers for chemicals. Agriculture keeps pace with technological progress. From current research will come the know-how that farmers and food processors need to produce foods more efficiently. But this knowledge, even with an adequate supply of chemicals, is not enough. The farmer must see a profit in use of chemicals.

Department of Agriculture statistics indicate that normal domestic and export requirements of foodstuffs can be produced on fewer acres. This

realization prompted enactment of the Hope-Flannagan Bill, Public Law 733, 79th Congress, generally known as the Research and Marketing Act of 1946. Farmers today produce 20 percent more corn from 10 percent fewer acres than they did two decades ago. They produce over 50 percent more potatoes per acre than they did ten years ago. Vigorous application of research findings to agriculture has made these achievements possible.

Current output of foodstuffs would be impossible without fertilizers. About 20 percent of total crop production is due to fertilizer application. Not only increased yields but better quality crops result from use of (1) nitrogen, phosphate and potash chemicals; (2) such essential soil elements as salts of copper, zinc, boron and manganese; and (3) liming materials. Above all, fertilizers preserve soil fertility.

In 1910 domestically produced fertilizers contained 63,520 tons of chemical nitrogen and 78,142 tons of organic nitrogen. Data in Table V show how the fertilizer industry has developed from a scavenger to a huge chemical industry. From wartime expansion in ammonia and nitric acid production has come the increased use of ammonia solutions containing ammonium nitrate and the establishment of granulated, conditioned ammonium nitrate as a fertilizer material. The recent pattern of chemical nitrogen consumption is here to say. Minor modifications may involve (1) expansion in direct application of ammonia to the soil, (2) greater production of ammonium sulphate from synthetic ammonia and (3) possible increase in production of urea and hence U.A.L. solutions. Most new ammonia plants are in areas where production costs are relatively low and in regions where nitrogen fertilizers are becoming more important. Wartime investment in these plants will add as much to national welfare as any comparable expenditure.

Table IV presents a vivid statistical picture of the sensational growth of fertilizer industry. About one-third of entire United States sulphuric acid production (3 million tons of 100 percent acid) is needed currently to make phosphate fertilizers. Concentrated acid from contact plants, with its economic and operating advantages, is now used more extensively by the fertilizer industry, particularly in new plants.

Even the current high production of fertilizers, according to government agencies, is not enough. Shortages are reported in new areas of crop production and regions where widespread use of fertilizers is recent. Market research is needed to evaluate quantitatively the nature and size of the fertilizer shortage. Curves of Fig. 1 throw light on the national situation, and data in Table II relate to estimates of fertilizer used on principal crops.

Fertilizer Demand

In some quarters a recession in fertilizer consumption is expected after wartime agricultural support programs expire. This belief is based largely on the curves in Fig. 1. Magnitude of any slump, if it does occur, will be cushioned by at least five factors.

First, farmers have learned the agronomic importance and economic value of fertilizers under the wartime programs. Under conditions prevailing during the past few years, farmers realize about a four-fold return on investments in plant foods.

Next, farmers may use more chemicals to insure good crop yields if and when acreage goals are made a condition for participation in price-support programs. Such a trend has been noted in potato production where fertilizer consumption, usually close to the recommended maximum rate of application, increased from about 540,000 tons in 1938 to 983,000 tons for a slightly smaller acreage in 1947.

Third, farmers with high incomes can purchase more chemicals. A floor under consumption of farm products has been blueprinted by the Administration to keep agriculture on a level with other segments of the economy and to obtain high income and employment.

Fourth, curves of Fig. 1 emphasize the historically stable agriculture of the eastern and southeastern states. In recent years new areas, particularly the North Central States, have become larger users of fertilizers. This development corresponds to the opening up of new territories insofar as intensive fertilization of crops is concerned. Hence, estimates of future fertilizer requirements need to be related to the permanently enlarged market.

Last, farmers know that it takes chemicals to keep soils fertile. As the federal government is well aware, future welfare of this nation depends on the fertility of its soils. To take care of a growing population, the United States has only between 400 and 500 million acres of suitable cropland. Safeguards against depletion and erosion of farmlands are needed to maintain and improve nutrition standards. Many bills dealing with the fertilizer problem have been introduced in recent years. Fertilizer industry has met the challenge of new conditions even under wartime difficulties. More research in federal, state and industrial laboratories will lead to better farming practices and improved conservation measures.

Economic Poisons

Next to weather conditions and soil fertility, insects and plant diseases are the most important natural factors affecting crops. Pests can destroy unprotected crops. Unless he controls pests and plant diseases, the farmer may lose his investment in land, seed, fertilizer and labor. Insecticides and fungicides reduce the farmer's risks.

Some of the more important economic poisons are listed in Table III. Indicated consumption is approximate, as the present situation in the economic poisons field is changing.

Trends in production and marketing of economic poisons include: (1) increasing use of organic synthetics; (2) greater emphasis on concentrated insecticides with newer and more effective additives and carriers; (3) realization by the farmer that investment in such crop insurance is a wise, if not an essential, aspect of crop production; and (4) closer cooperation of industry with federal and state agencies in developing, testing and evaluating in the field the new economic poisons.

Advent of DDT and its homologs, of chlorinated camphene, chlordane, benzene hexachloride, tetraethyl pyrophosphate, piperonyl butoxide and the thiocarbamates but foreshadows the useful plant medicinals that synthetic organic chemistry will provide. Chemists will develop new synthetics having either greater specificity or greater general efficacy, as well as less toxicity to warm-blooded animals. Synthesis of molecules containing atoms or groups to combine insecticidal and fungicidal control appears reasonable. Some of these molecules, in conjunction with adjuvants, may be designed along pyrotechnic lines to provide timed control of insects and fungi and thus reduce the cost of spray programs.

Replacement of older toxicants by synthetics has amazingly improved crop yields. This increase in yields has been more than can be attributed to mere control of visible insect life. Evidently, a healthy plant like a healthy person is more productive. No chemical or other techniques have as yet been developed to determine comparative well-being or potential productivity of plant life. Obviously, by waiting until the end of the growing season, the productivity can be measured accurately. But this practice may not always be necessary. It was precisely these considerations that led to evolution of unit processes in organic

Food Industries: Chemical Consumer

Filling the world's market basket is the king-sized job of U. S. food processors. To do it, they require such varied chemicals as flavors, colors, bleaches, preservatives and refrigerants. Sanitary, attractive food wrappings call for plastics, waxes and resins.

Table VI. Major Classes of Chemicals Used in Food Industry

Chemicals Employed	Approximate Average Annual Value
Food Supplements Citric acid, lactic acid, tartaric acid, acetic acid, benzaldehyde, carbon dioxide, caffeine, vitamins, food dyes, synthetic fruit flavoring agents, phosphorus compounds, lecithin and sodium glutamate	$100,000,000
Bleaching, Aging and Preserving Chemicals Chlorine, hydrogen peroxide, formaldehyde, sulphur dioxide, potassium bromate, nitrogen trichloride, benzoates and salt	2,000,000
Sanitation Chemicals Soaps, organic wetting agents, alkalis, alkali silicates and alkali phosphates	25,000,000
Refrigeration Chemicals Carbon dioxide, Freon and ammonia	35,000,000
Food Wrappings Cellophane, Pliofilm, paraffin, microcrystalline wax, zein, resins and colloids	50,000,000
Total value	$212,000,000

synthesis and the formulation of principles to permit reasonably accurate control of the factors underlying major reactions.

Forecasting demand for economic poisons is hazardous. There are too many different insects and too many different toxicants. The complexion of the economic poisons industry, moreover, is changing. But the same economic, agronomic and other factors that apply to the future market for fertilizers are at work here. Besides, salesmen of this crop insurance have not tried as hard as salesmen of life insurance to find customers. For many years now most chemical products have practically sold themselves. But an alert chemical industry is now adding to its investment in the remarkably growing field of chemical market research.

In preparing, preserving and packaging food under sanitary conditions, the food industry uses a great variety of chemicals. These may be classified as (1) food supplements; (2) bleaching, aging and preserving chemicals; (3) sanitation chemicals; (4) refrigerants; and (5) food wrappings. Food supplements are added to foods to improve their nutritive value, flavor and appearance. They are generally metabolized by the body and may constitute an integral part of the food.

Use of these chemicals in the food industry is shown in Table VII. The 1943 values of foods are used to avoid a distorted economic picture. Estimated value at January 1948 prices would be about $29.0 billion instead of the indicated $14.9 billion.

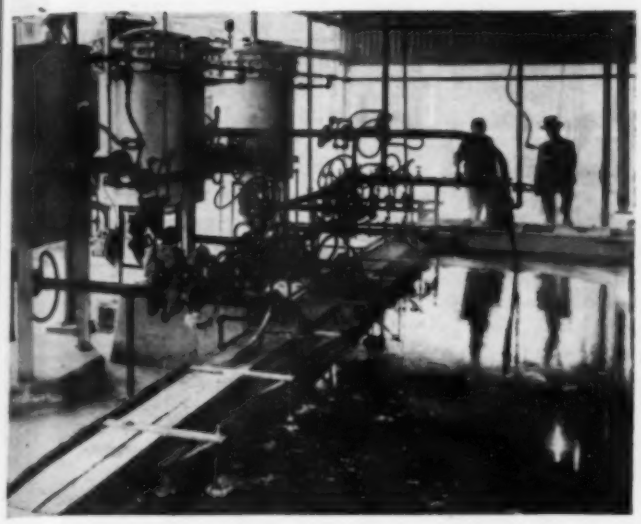
Most food processors use chemicals at some stage of their operations. Dependence on chemicals varies not only in various branches of the industry but also, as records of the Food and Drug Administration show, in individual plants within a branch. Dollar value of chemicals used by food processing industry is only slightly more than 1 percent of the wholesale value of food products. This means a market of about $200 million, as shown in Table VI.

Table VII. Foods Processed, Production, Estimated Value and Chemicals Used in 1943

Food Industry	Production	Estimated Value	Chemicals Used
Fish	4,070,000,000 lb.	$178,000,000	Carbon dioxide
Candy	2,350,000,000 lb.	362,000,000	Edible acidulants, lecithin, food colors, chemical flavoring agents
Meat	25,000,000,000 lb.	4,000,000,000	Carbon dioxide, sodium nitrate, agar, benzoic acid
Carbonated beverages	18,500,000,000 bottles	365,000,000	Carbon dioxide, edible acidulants, food colors, caffeine
Flour (wheat, for baking)	11,818,450 tons	900,000,000	Bleaching and aging chemicals, vitamins, iron salts, phosphates
Bakery products (incl. yeast)	17,700,000 tons	2,000,000,000	Nitrogen compounds, phosphates, edible acidulants, food colors, pectin
Dairy industry Ice cream Fluid milk	400,000,000 gal. 118,950,000,000 lb.	4,000,000,000	Carbon dioxide, alginates, gelatin, food colors, sanitation chemicals, sulphuric acid, phosphates, citrates, methyl cellulose
Jams and jellies	650,000,000 lb.	100,000,000	Edible acidulants, pectin, food dyes, flavoring agents, benzoic acid
Poultry (chickens, broilers, turkeys, incl. eggs)	3,500,000,000 lb.	2,000,000,000	Formaldehyde, potassium permanganate, phenothiazine, vitamins, magnesium sulphate, medicinals
Total Value (1943), $14,905,000,000			

These chemicals were wartime essentials in processing foods to feed the armed forces overseas and civilian workers at home. Now in peacetime these chemicals make better things possible for better living. United States surpasses all other nations in its insistence upon sanitary foods in sanitary packages.

Future market for chemicals in the food industry can best be evaluated by considering certain road markers. United States serves the world's largest market. To live up to the claims it makes to its customers in various advertising media, requires scientifically controlled production of uniform, sanitary, stable and attractively packaged products. Nationwide competition compels technologic advances and improvements in processes and products, which in turn bring greater use of chemicals. County, state and federal governments are not likely to lower sanitary or nutrition standards they have set for the food processing industry. Increases in urban population make more people dependent on the food industry. Even the rural population takes advantage of good roads to supplement farm produce by stocking up on factory-processed foods. All these road markers indicate that the food industry of America will continue to be a good and stable market.



NIAGARA FILTERS removing fly ash which would interfere with sulphur burners and reduce efficiency of catalyst

KELLY FILTERS and modifications of them have been in service removing impurities in sulphur for a decade

Filtration Solves Sulphur Difficulties

JAMES A. LEE
Managing Editor, *Chemical Engineering*

FILTRATION OF MOLTEN SULPHUR IMMEDIATELY BEFORE PROCESSING REMOVES IMPURITIES, THUS INCREASING OUTPUT OF ACID PLANTS

When processing sulphur, often difficulties have arisen due to impurities. These have seriously affected production with accompanying loss of output. Filtration of the molten sulphur immediately prior to processing has proved to be the solution to this troublesome problem. Several types of filters have been in use for this purpose for some time, at least one of these, the Kelly, for as long as ten years.

Most sulphur when mined is a bright yellow and is exceptionally pure. When this sulphur is shipped in liquid form in tank cars from the mines it arrives at the chemical plants just as clean and acid free as when it was shipped. A smaller amount of sulphur when mined contains about 0.2 percent carbonaceous matter which gives it a dark color. For some uses this impurity is not objectionable, for other purposes it must first be removed.

This article is not only concerned with the carbonaceous material but also with the "fly ash." In transit to consumers' plants, sulphur may become contaminated with cinders from the locomotive and with other foreign materials during trans-shipment. While in storage at consumers' plant, usually in the open, sulphur may become contaminated by air-borne dusts of various kinds. Customers often store their supplies of sulphur near the open near supplies of other raw materials—coal, rock phosphate, lime, etc., which contribute their share.

The conventional method of handling sulphur in consumers' plants is to melt it and hold it in large settling tanks. Here coarse particles settle rapidly. But fine dust settles out slowly and sulphur contaminated with such dust will have an ash content of 0.02 percent even after being allowed to settle for 24 hours or more. To obtain better clarification, filtration is necessary.

If the foreign matter is not removed from the sulphur before it is used it carries over with the molten sulphur in substantial quantities to plug burners, accumulate in the combustion chambers or pass on with the gas to deposit on the catalyst bed with plugging effect causing undesirable loss of production. Gas filters ahead of the converters of the contact sulphuric acid plant have not been entirely satisfactory as a means of protecting the catalyst.

On a recent trip through the South several plants were visited that have had considerable experience with filters of the Kelly, Niagara and Adams

types. There were standard Kelly presses and modifications of it. The Niagara has the general appearance of a beer filter. The Adams filters were equipped with either porous stoneware or porous carbon.

Several Kelly type filters have been in this service for ten years or longer. Their principal features are large filtering surface and large filter cake capacity. One plant is equipped with two 450 sq. ft. Kelly filters. They have continuously handled a very large tonnage of sulphur per day over a long period. This type of filter is being used whenever carbonaceous matter must be removed from dark sulphur and also in plants interested in filtering out fly ash.

Kelly Filter

The Kelly filter is steam jacketed, and permits quick and easy cake discharge. It has Dutch weave 18-8 stainless steel filter cloth, and is equipped with grooved rim leaves on which the filter cloth is caulked into place with a wire inserted asbestos packing. A precoat of filteraid is the actual filter medium.

It was found that the carbonaceous matter in dark sulphur forms a very thin and impervious cake thus necessitating the use of filteraid as an admixture in the sulphur charge to overcome retardation of filtration rates. With bright sulphur this admixture is seldom necessary. A precoat of $\frac{1}{16}$ in. to $\frac{1}{8}$ in. thickness was found to be most satisfactory, and the filtered admixture requirements never exceeded a maximum of 1 lb. per long ton of sulphur. The use of proper filteraid for precoat and admixture provides a desirable reduction in acid content of the sulphur. The optimum filtration temperature for sulphur filtration is between 280 and 290 deg. F. Under these conditions the filtration rate on run-of-mine crude sulphur in the molten state was established at 0.2 long tons per sq. ft. filter area per hour.

Cake Handling

It was found advisable to air-blow the filter cake upon completion of the filter cycle, as this holds sulphur loss in the cake to 60 percent by weight and greatly facilitates cake handling. When air-blown, the cake is easily discharged from the filter in small solid pieces.

This filter can be taken off-stream, cleaned, and returned to service in a minimum amount of time. Under normal conditions it requires about 15 min., exclusive of precoating time, the latter requiring 20 min. to insure complete and uniform deposition of filteraid on the filter leaves.

Modified Kelly Filter

In one of the plants visited, a modified Kelly filter was being used to bleach the sulphur rather than reduce the ash content, although there was reduction of ash during the process. The bleaching agent was Filtrol. Filteraid is also used. The former is used at the rate of from 0.2 to 0.6 weight percent basis on the sulphur treated. Filteraid used was at the rate of 150 lb. per 300 tons of sulphur.

When the filter was cleaned and the leaves were ready to be replaced in the shell, filteraid was thrown into the bottom of the shell. When the molten sulphur was charged into the filter it picked up the filteraid and began depositing it on the leaves.

Filtrol Feed

Filtrol was handled by a feeder of the company's own design. It was dumped manually into an open hopper and fell into the throat of a standard venturi where it came in contact with molten sulphur discharging from a one-inch jet directly into the venturi throat. A device in the outlet of the jet pipe induced turbulence and suction in the venturi so as to cause rapid mixing of Filtrol and sulphur and prevent Filtrol loss in the form of dust.

The lower end of the venturi is welded into a 6-in. steel pipe leg which carries the mixture to the tank where the sulphur and Filtrol are kept mixed by means of mechanical motor-driven stirrers. The venturi and pipe leg are jacketed.

After the Filtrol had been added and agitated for 30 min. the venturi system was closed and the valves opened to the filters by means of a vertically mounted motor driving a horizontal split case centrifugal pump.

A filter cycle was about 2 hr. between charging and taking down for cleaning, although the time varied appreciably. During the period there were usually three "cake droppings," accomplished by temporarily shutting off the incoming sulphur from the filter, which permitted part of the cake on the leaves to drop off and fall into the bottom of the shell.

A filter can be taken down and cleaned in 15 min. Cleaning is done by unbolting the head, sliding out the leaf assembly, which is on wheels, and allowing the cake on the leaves to drop off through an opening in the floor. Some of the cake is used for surfacing streets around the plant.

In another plant that was visited Kelly filters were used to clean sulphur that had been on the ground for several years during which time it had picked up from 2 to 4 percent dirt and between 10 and 12 percent moisture. The engineers in the plant were well pleased with the filtration which resulted in pure bright yellow sulphur. In this plant Kelly filters also were used to remove the small amount of hydrocarbons present which darken the color. This material is similar in nature to fuel oil and if overheated becomes coke or asphalt-like and gives trouble with valves, pumps, and other equipment.

At this plant the stainless filter screens eventually became "blinded" by filteraid, asphalt-like material removed, fly ash, etc. Formerly the screens were cleaned by burning as much of the material as possible and washing off the remainder. This method had been discontinued in favor of dipping the entire leaf in 20 percent caustic and heating above the melting point of sulphur. This had proved very satisfactory.

Niagara Filter

In the case of the Niagara filters seen in operation, the molten sulphur was pumped from the sulphur pits to a mixing tank in which it was mixed with filteraid, diatomaceous earth. The mixture was pumped to the filter where it served as a precoat on the leaves.

This filter has a capacity of 150 tons per day. It has 80 sq. ft. of filtration surface in each of the two filters making up the unit. The leaves, frames holding the leaves, and the sealing edge of the cover were fabricated from 316 stainless steel. Use of this metal has been necessary to prevent corrosion due to acid formed by action of moisture on sulphur during shipment and storage.

Filtration reduced the ash from 0.03 percent to 0.003 percent. This filter also removed some iron salts formed as a result of corrosion while in transit.

In this case filtering of the sulphur had been resorted to primarily to prevent ash building up a layer on the catalyst rendering it less efficient and reducing the flow of gas through it. To a lesser extent the sulphur was filtered to remove ash which would interfere with the burners. This filter was cleaned fairly easily.

Filtering out impurities had eliminated the pressure rise across the gas filter and the general plugging and

subsequent cleaning operations. Further, it had been possible to prolong the operating cycle of the plant considerably which of course means increased yearly production. Engineers on the job were enthusiastic with the results of the filtering operation done by this filter.

Introduction of Impurities

The president of a Rhode Island chemical company reports that when transportation of sulphur from Texas by boat was practical there was little trouble through introduction of impurities in the sulphur. The sulphuric acid contact plant converter could be operated for 12 to 15 months before it became necessary to take it down for cleaning.

But the movement of sulphur from Texas in open cars has resulted in contamination by coal ash and dirt raised from the track ballast by passing trains. In fact the impurities have been so serious that it became necessary to install large sulphur melting pits. As these were not sufficient to remove all impurities, about six months ago a Niagara filter was added.

There has been very little difficulty with the filter and daily analyses of the filtered sulphur show that the unit is doing an excellent job of ash removal, so much so that it is likely that converter cleaning will be on an 18 to 21 months basis.

Adams Filter

In yet another southern plant the filtering problem was to remove phosphate rock dust, fine Florida sand, and calcium sulphate. This acid plant had installed Adams filters that are giving very satisfactory results. These filters are cleaned every three weeks by back washing with steam. Porous carbon tubes are mounted vertically from a metal tube sheet in a steam jacketed steel shell. The liquid sulphur is introduced to the shell and is passed through the porous tubes, the solids being retained on the outer periphery of the tubes.

It is reported that a producer of hydrogen sulphide from vaporized sulphur is filtering the sulphur in a steam jacketed plate and frame filter. Kraft paper is the filtering medium. This plant uses 10 tons of sulphur per day and cleans the press once a day. This filter has been in use for several years and is said to be satisfactory.

Other methods were being tried for removal of impurities. In one case the sulphur was vaporized and the vapor burned in the combustion furnace of the acid plant. The molten sulphur residue which was used to flush off the impurities was filtered in a Niagara filter. The purified sulphur was returned to the system.

When impurities in the sulphur supply are removed by filtration it is not necessary to have the large sulphur pits that have long been part of an acid plant. These pits generally hold a 72-hr. supply of molten sulphur. This gives ample time for the larger impurities to settle out. With the use of filters it will only be necessary to have a pit large enough to permit the sulphur to be melted and the temperature raised to 280-290 deg. F. for processing.

In some plants trouble is experienced as a result of sulphuric acid formed by the action of moisture on the sulphur between the time it leaves the mines and the time it is used in the chemical plant. This source of corrosion of the equipment is neutralized by sprinkling lime on the sulphur in the railroad cars before unloading and also by the addition of lime to the precoat for use in the sulphur filter.

Suitable valves for the filters have been something of a problem but it has been satisfactorily overcome. Several valves are now in use, among them is a lubricated plug valve with steam jacketed cocks which is used in the piping system for charging the filters. Another satisfactory plug valve has a packing valve at the bottom of the valve which is important for this purpose.

Thyssen Galocsky, Lurgi Processes Promising for Gas Manufacture

Two promising gasification processes, Thyssen-Galocsky and Lurgi high pressure, were utilized by the Germans during the war to manufacture gas for Fischer-Tropsch liquid fuel synthesis. Like earlier processes, both make gas from coal or coke, oxygen and steam.

Chief advantages of the Thyssen-Galocsky generator is its simplicity and ability to use fuels whose sintered ash clogs other generators. The Thyssen-Galocsky operates at a temperature high enough to melt ash in the fuel processed. Provision is made for withdrawing the molten ash.

Both synthesis and heating gases can be manufactured by the process. To raise the calorific value of the heating gas, part of the product can be converted to hydrocarbons by Fischer-Tropsch synthesis and blended back into the gas. Professor Galocsky, for whom the process is named, claims it has a thermal efficiency of 86 percent, consumes only 0.15 volumes of oxygen per volume of purified gas, and has a capacity of 1,700 kg. per hr. per sq. m. of grate area.

In the Lurgi high pressure gasification system, coal is converted to gas by reacting it with oxygen and steam at about 20 atmospheres pressure. Operating under pressure gives two advantages. Gas velocities through the unit are reduced and removal of condensable products in the gas stream is simplified.

The standard Lurgi generator is a tall cylindrical pressure vessel, water-jacketed and partly brick-lined. Fuel is introduced through a lock hopper on top of the generator. Charge is dried by hot crude gases which leave through an outlet on the side of the dome of the vessel at temperatures as low as 300 deg. C. Dried fuel is carbonized as it passes down the generator. It continues down through the reactor to the gasification zone at the base. There it reacts with steam and oxygen which come up from the bottom through the hollow shaft which turns the grate. Methane formation occurs just above this zone as the gases cool. Temperature of combustion depends on the melting point of the ash, and is controlled by the amounts of steam and oxygen admitted. Ash is continuously fed to the inlet of an ash chamber below the revolving grate. There it is periodically removed. Tar and benzol in the gas are recovered by standard methods.

Thyssen-Galocsky and Lurgi generators were first introduced into Germany during the war. They were used less extensively than the Winkler generator, oldest apparatus for generating synthesis gas from coal, oxygen and steam.

Both of the newer gasification processes are described and illustrated in an OTS report "Gasification of Coal,"* prepared by investigators C. A. Johnson, H. F. Buschow and L. E. Carlsmith. The report also reviews the Koppers carbonization-gasification process and Fischer-Tropsch liquid fuel synthesis.

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* PB-80330 "Gasification of Coal," mimeographed, $1.50, 41 pages. Order from OTS, Department of Commerce, Washington 25, D. C.

EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

STILL GOING STRONG

On Thursday, April 22, the department of chemical engineering at Michigan will be fifty years old. On Thursday, April 29, its beloved professor-emeritus, Alfred Holmes White, will quietly observe his seventy-fifth birthday. But on Saturday, May 8—just in advance of the AIChE regional meeting in Cleveland—both of these auspicious anniversaries will be duly celebrated on the campus at Ann Arbor. Many loyal sons and grandsons of the department will gather with a few adopted sons to make this a happy and memorable occasion.

In 1898 a handsome young professor returned to Michigan after a year of graduate study under Lunge and Gnehm at the Polytechnicum in Zurich. He began to teach chemical technology in what was to be the second chemical engineering program announced in the United States. The first was ten years before at the Massachusetts Institute of Technology. Michigan's course had the advantage of being located in the engineering college but was launched with the hearty cooperation and support of the chemistry department. Under such favorable circumstances it has had a career of which all in the profession are duly proud. Our congratulations to the department, to the professor and their progeny.

COMMENDABLE COOPERATION

Chemical enterprise has again demonstrated its neighborliness and desire to cooperate in the public service. An unfortunate break in a hydrogen unit permitted a flash fire in the government-owned Cactus Arsenal early in March. Large damage to instruments and minor parts resulted. Fortunately there were no injuries sufficient to put anyone in the infirmary. But rebuilding immediately became a serious problem for the government and for the agent operator.

Contact was made with all of the other plants making synthetic ammonia. The response was immediate and cordial. Available spare instruments, parts, and supplies were forthcoming at once. The result is going to speed up materially the resumption of ammonia production at Cactus. It is also wholesome evidence of the desire of chemical industry to cooperate in offsetting the losses to the public caused by such unfortunate accidents.

CCDA + CMRA = PROGRESS

Chemical industry is fortunate in having two young and vigorous associations to push ahead its joint efforts in commercial research and development. Both held interesting and worthwhile sessions in New York last month. Despite closely related interests and some duplication in membership, there was little overlapping in the programs and discussions. Seven stirring talks were made before the Commercial Chemical Development Association, of which Lauren B. Hitchcock, vice president of the Quaker Oats Co., is president, and John B. Calkin of Union Bag and Paper Corp. was chairman in New York. In six other papers the Chemical Market Research Association, at its New York meeting, traversed related fields under the chairmanship of its president, Paul J. Carlisle of E. I. du Pont de Nemours & Co.

Elsewhere in this issue is a typical sampling of the talent these two virile associations had before them in their separate and independent sessions. It is the only good argument we know against their merger and consolidation. Competition, even between brothers in research and development, can sometimes provide the incentive for growth and progress.

A LAST CALL TO REGISTER

Chemical manufacturers of insecticides, fungicides, disinfectants and related pest-control chemicals should by now have registered their products with the Department of Agriculture. The federal law gives no option to the control officials after June 25 this year. A "last call" has gone out, and laggards must hurry to comply.

The new act may be working some slight inconvenience on the producers of insecticides. The technicalities imposed are proving a bit bothersome at the start. But control officials seem to be sincerely cooperating in matters of registration and label reviews. It is fortunate that this spirit of vigorous application of the law in a rational manner prevails. Without it there would be grave difficulty in meeting either the letter or the spirit of the law. Fortunately, too, the industry is attempting to do its part. Under these circumstances only the laggards and the uncooperative in industry are likely to suffer.

TECHNOLOGICAL STAGNATION

Again the Machinery and Allied Products Institute has furnished industry with informative and thought-provoking literature on the subject of taxation. One of the more significant of these reports, in our opinion, is that entitled "Technological Stagnation in Great Britain." Apart from some controversial features that have aroused the ire of several of our English contemporaries, we see in this document some related principles and interpretation that are readily applicable to problems faced by engineers and executives in our process industries. It would be profitable for more to study the document.

MAPI rightly worries lest this country follow blindly along the same road which leads to "the erosion of savings and the destruction of investment incentives." It seems

to have demonstrated rather persuasively "that we are by no means immune to the degenerative processes that have sapped the vitality of industry overseas."

Even the engineer who thinks that he is concerned only with machinery, and but little interested in management, can profitably analyze this and the other pamphlets published by the institute. They make it clear how a different weighting must be given in the choice of new equipment when excessive taxation bears heavily on capital goods.

The institute points out very clearly in another of its pamphlets, "Capital Goods Industries and Tax Reform," some of the recommendations which must be adopted if we are adequately to protect our position and investments in process industries. Certainly the merit of new equipment investments will be largely determined in some cases by the tax carryover and carryback of losses and by the depreciation policy applied by the tax collector. We commend this literature for critical review and study.

IS IT BACK TO COAL?

PERHAPS never before in American history has the stampede from one fuel to another been as sudden and as sweeping as of late. Householders, commercial establishments, manufacturing industries, even railroads, are rushing pell-mell to the use of fluid fuels. The effect of this rush is now producing secondary factors of concern to the chemical engineer.

We are not much worried by public utilities who forbid further conversion of heating facilities from solid fuel to city gas. We are not worried about the increased use of diesel power on the railroads. But every executive and engineer in industry using large quantities of electricity for fuel must be concerned with the rapid rise in prices for these energy supplies. Process industries use several billion dollars worth of energy each year and can ill afford to absorb huge percentages of increase in cost.

In a few cases of which we have heard lately there is a serious study being made of the need for returning to coal as a source of factory heat and power. But with John Lewis upping miners' wages and the Interstate Commerce Commission authorizing higher freight rates, we wonder how wise it is to rush promiscuously back to solid fuel. We know, of course, that in many cases coal will come back into dollar preference for applications for which it seemed only recently to be passe. And, certainly no management today can ignore the need for recalculating its fuel bill in light of changing conditions.

A FUEL FALLACY

IN MOST respects the engineering conclusions of the staff of the Federal Power Commission have been sound and constructive. But one recent finding which happens to concern process industries rather deeply, seems to us to be in error. This deals with the formulation of a proper policy to handle so-called "dump" gas.

The error made by some of the FPC staff appears to be based on a feeling that interruptible gas contracts are bad for both the small household and the large industrial users. One theory is that such gas should be saved for the future. Another argument stems from the premise that the low-delivery price permissible on big industrial gas deliveries raises the cost of the rest of the gas to other users. Neither of these conclusions is sound, in our opinion.

Data published by FPC engineers disprove both of them. It is not true conservation to leave gas unused in the ground while a pipeline which can carry it to market lies partly idle. The difference in rate of exhaustion of fields of supply occasioned by using this last portion of pipeline capacity is not such as to threaten present users with unduly early interruption of gas supply.

Use of a pipeline to its maximum capacity throughout the year gives the lowest delivery cost to all customers. The cost to the small user is less when even the last 10 percent of capacity is used by the pipeline company for gas service to big users served at a very low price. These big users are contributing substantially to the capital charges on the pipeline. They thus reduce the charge which must be placed on the small user for his smaller takings of gas.

We do not think that a careful study by the Federal Power Commission is going to leave them in any doubt on these points. We believe that the best interest of both utility customers and small pipeline customers is served only when every pipeline is used as nearly as possible at 100 percent capacity load factor. We believe that industrial gas users who can afford to chance interruptible gas contracts are among the most constructive parts of the gas-using community. Relative rates must, of course, be properly adjusted. When they are, the little fellow benefits from service to the big man quite as much as the big man himself.

CUSTOMER WARNINGS

TREMENDOUS progress is being made in the use of chemicals as insecticides, weed killers, rat-control agents and for other services to the layman. Products almost unknown a few years ago are now every-day articles of application in the garden, on the farm, and even in the household. But with this encouraging trend has come a whole new set of public relations problems.

Lately makers of 2,4-D have discovered to their regret that some serious secondary difficulties may follow in the wake of this effective weed killer. Not only are the weeds killed but sometimes nearby shrubs, plants and crops have been damaged as the dust and the spray are carried by a gentle breeze beyond the intended point of use. Some of the esters of this poison are so volatile that vapor transfer has occasioned similar difficulty.

The correction is obvious, but not easy of attainment. Users must be guided to more careful use of the poison so that unintended wandering from the target may not cause serious loss. Producers have more than their reputation at stake if they do not take the maximum precautions to guide and warn the ultimate customer. Already there have been threats, perhaps actual suits, against producers for marketing these goods without adequate labels.

This is just another evidence of the extreme care which is needed in the development of early markets for a new commodity or in the new applications of an old one. Everlasting vigilance and concern for the well-being of the ultimate user, as well as the first customer, are required.

THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

February Contest Prize Winner

BOILING TEMPERATURE SUCCESSFUL AS CONTROL VARIABLE FOR MURIATIC ACID ABSORBER

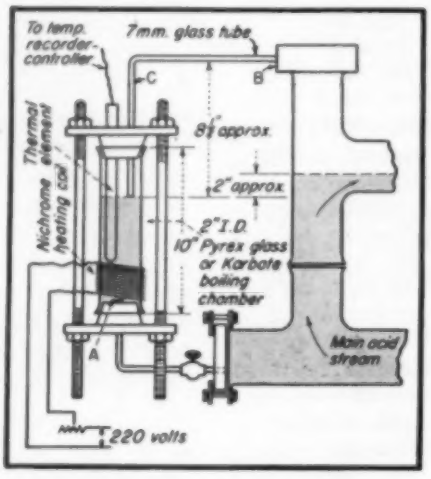
R. C. RAHN
Diamond Alkali Co., Painesville, Ohio

SEVERAL weeks ago I constructed and installed a device for continuously recording and controlling the product acid concentration of an HCl absorptive system. The device is performing very satisfactorily. Since HCl absorption systems are quite common the method could be used in many other plants.

The device eliminates tedious adjustment of the amount of absorbing liquid feed to the absorber, and the inconvenient handling of acid samples to measure density; the latter being the usual method of process control. In addition, the device measures acid concentration much more accurately than can be done by density measurements with a hydrometer. The product is always of uniform quality and overheating of equipment, which could damage ceramic absorbers and scrubbers, is prevented.

The instrument described below boils and causes to circulate a very small portion of the product acid leaving the HCl absorber. The boiling temperature, being a direct function of the muriatic acid concentration, is recorded and used to control an air-operated, diaphragm-type valve in the absorbing liquid feed line to the absorber. The boiling temperature seems to be an excellent physical property for use in control as there is approximately a 10 deg. F. variation for 1 percent change in concentration. The true boiling point of the product acid need not be obtained so long as temperature is a function of concentration. Very close to true boiling temperatures were obtained, however, with the unit tested.

In the sketch shown a small portion of the product acid from the main stream enters a glass boiling chamber at A, and returns to the main stream at B. Heat is supplied for boiling by a rheostat-controlled Nichrome electric resistance wire wound around



Acid boiler used in control of HCl concentration

the glass chamber. Circulation of muriatic acid is caused by HCl vapors which promote a gas-lift effect in the glass tube, *C*. Boiling temperature may be measured and recorded by any standard temperature recording-controlling instrument. If only a record of acid concentration is desired, the instrument obviously need only be a temperature recorder. It is essential that the end of tube *C* be located somewhat lower than the level of acid in the main stream.

HOW TO HEAT VALVES TO PREVENT FREEZING

PAUL C. ZIEMKE
Safety Engineer
Oak Ridge, Tenn.

WHEN materials handled in pipes are capable of setting up on cooling, it is important to prevent the freezing of valves and stopcocks. Usually, with a good job of insulation, the heat from the process will carry over to the next operation, but in long lines, or with doubtful insulation, it is necessary to provide heat along the line to prevent the blockading of vulnerable points.

Ordinarily this is done by "steam-tracing" the line. In the case of larger fittings there is often much to be said for the use of electric strip heaters which may be heated and bent to conform to the radius of the fitting, then covered with good insulation. For smaller lines the fittings can be heated with exhaust or process steam by turning as many coils of copper tubing on to the fitting as space allows, without adjacent turns being in contact. The interstices are used for the application of solder by the mechanic. Silver soldering at 5 or 6 in. intervals lends rigidity and mechanical strength and also maintains the tubing in thermal contact with the fitting.

NOMOGRAPH GIVES NUMBER OF THEORETICAL CONTACTS

WALTER H. STANTON
Webster Groves, Mo.

IN DISTILLATION calculations it is desirable first to establish the minimum limits for a given separation, namely, minimum reflux ratio and minimum number of theoretical contacts.

For binary mixtures these minimum limits can be established by use of the McCable-Thiele diagram[1] or from nomographs prepared by E. N. Smoker[2] or from the algebraic expressions represented by the nomographs.

For multi-component mixtures, the minimum reflux ratio can be estab-

MARCH WINNER

A $50 prize will be issued to

ALFRED B. BABCOCK, JR.

Chemical Engineer
Casein Co. of America
Greensboro, N. C.

For an article presenting a slide rule for volumes at various depths in horizontal, vertical and conical tanks, which has been judged the winner of our March contest.

This article will appear in our May issue. Watch for it!

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the April winner will be announced in May and his article published in June. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at our usual space rates.

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

lished by a variety of methods, for example, the methods of Gilliland[3] and Scheibel and Montross.[4] The minimum number of theoretical contacts can be set by use of the Fenske Equation.[5]

This equation can be used for either binary or multi-component mixtures and gives the minimum number of theoretical contacts at total reflux. It is:

$$N_{min} = \frac{\ln (A/B)_D (B/A)_W}{\ln \alpha}$$

where N_{min} is the minimum number of theoretical contacts; A_D is the number of mols or pounds of component A, the light key, in the distillate; B_D is the number of mols or pounds of component B, the heavy key, in the distillate; A_W is the number of mols or pounds of component A, the light key, in the residue; B_W is the number of mols or pounds of component B, the heavy key, in the residue; and α is the average relative volatility of A to B.

A nomograph based on the Fenske Equation has been made and is presented here. To illustrate its use, a sample problem is given. Assume a mixture of three components: A, B, and C. It is desired to separate this mixture as tabulated:

Component	Feed, Mols per Hr.	Distillate, Mols per Hr.	Residue, Mols per Hr.
A	50	48.8	1.2
B	40	1.2	38.8
C	10	....	10.0
	100	50.0	50.0

Component A is the light key, component B is the heavy key. The average relative volatility α of A to B over the operating temperature range of the column is 2.0.

Connect the point 48.8 on the A_D scale with 1.2 on the B_D scale and continue the line to the scale marked Line (1). Connect the point 38.8 on the B_W scale with 1.2 on the A_W scale and continue the line to the scale marked Line (1). Note the point of intersection with Line (1) and continue horizontally across to intersect Line (3). Join the point of intersection on Line (3) with the point of intersection on Line (1) obtained by the $(A/B)_D$ division to obtain a point on Line (2). Connect this point on Line (2) with 2.0 on the α scale. The intersection on the N_{min} scale gives the answer of 10.4 theoretical contacts required for the separation. The nomograph offers a rapid solution to the type problem illustrated. It applies to binary or multicomponent mixtures and deals in total mols or pounds which is often advantageous in that a conversion to mol fraction or weight fraction is eliminated.

References

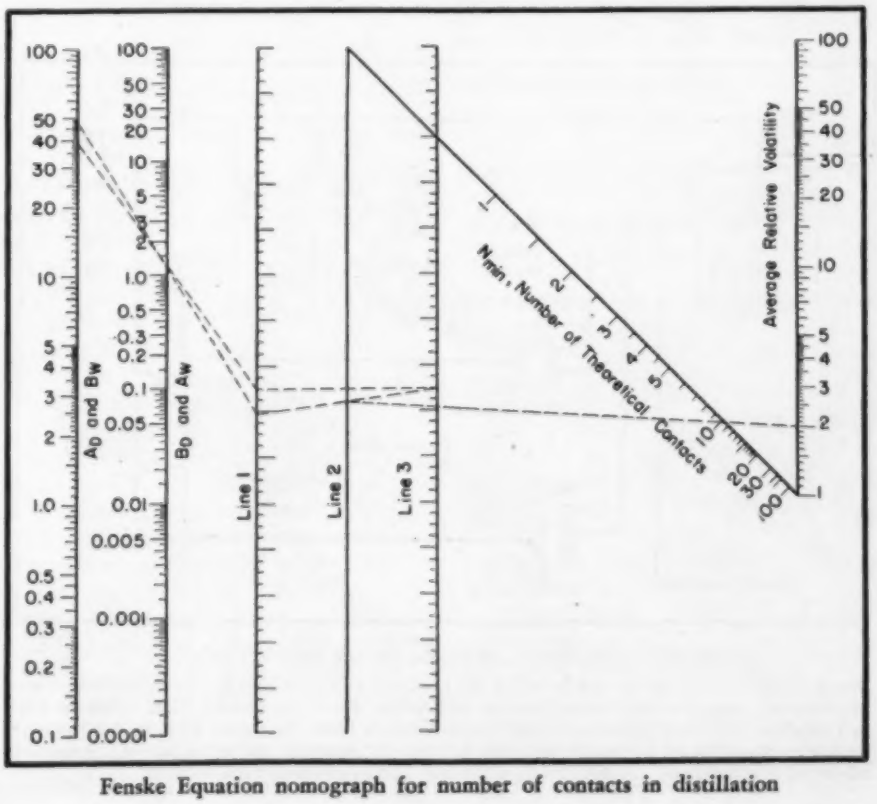
1. Badger and McCabe, "Elements of Chemical Engineering," 2nd Ed., p. 357-360, McGraw-Hill Book Co. Inc. (1936).
2. Smoker, E. H., *Ind. Eng. Chem.*, 34, 509-510 (1942).
3. Gilliland, E. R., *Ind. Eng. Chem.*, 32, 1101-1106 (1940).
4. Scheibel, E. G., and Montross, C. F., *Ind. Eng. Chem.*, 38, 268-272 (1946).
5. Fenske, M. P., *Ind. Eng. Chem.*, 24, 482-485 (1932).

HOW TO USE LOG PAPER MORE EFFICIENTLY

JAMES H. WIEGAND
China Lake, Calif.

THERE is an old trick which I have used for years, but it apparently is not familiar even to high-level engineers. It is most useful to those who have to plot data on log-log graph paper, which includes most of us. Normally, if a variable has a range from 30 to 170, for example, we would use two-cycle log-log paper, taking for granted the waste of space from 10 to 30 and from 170 to 1,000. Not only that, but we have to reduce the scale of our work by one half on the graph.

All that is necessary in this case is to use one-cycle paper and change the numbering on the axis. This is accomplished by multiplying each of the original numbers by a constant, usually two or five, since these factors yield new scales with suitable divisions. Let us take our example, and



Fenske Equation nomograph for number of contacts in distillation

use the factor two. Then 10 becomes 20, 20 becomes 40, 50 becomes 100, etc., up to 100 becomes 200. We now have one scale from 20 to 200 using up the full sheet of paper. The trick is, of course, equally good for the log scale of semi-log paper. Editors ought to find a use for it, too, in technical illustrations.

(*Editor's Note*—You're right, Mr. Wiegand. We'll try it.)

GOVERNMENT SURPLUS MAKES RUBBER LINED TANK

JAMES W. GLENN, JR.
Process Engineer, Lisk-Savoy Corp.
Kenmore, N. Y.

WE RECENTLY had need for a small rubber pickling tank and found the solution of our problem in the local dealers in government surplus stocks.

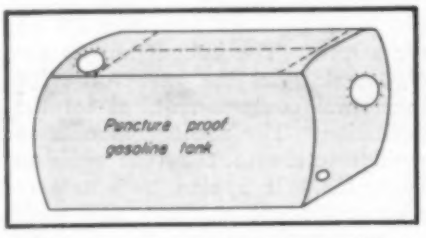
We secured a 75-gal. puncture-proof rubber gasoline tank, such as was used in war planes, at a cost of $0.98. Such tanks have been a drug on the market and seem to be available through at least one junk dealer in every large city. This, and the cost of labor and a little material for the cribbing to be described, constituted the only expense in making this tank.

First we cut the tank as indicated in the dotted lines in the drawing. The flaps were then turned back and nailed or screwed to a wooden crib made to fit the outside of the tank (approximately 4 x 2 x 2 ft.). For safety's sake we set the tank in an outer tank made of regular cement to which crushed limestone was added for aggregate to neutralize possible acid leaks.

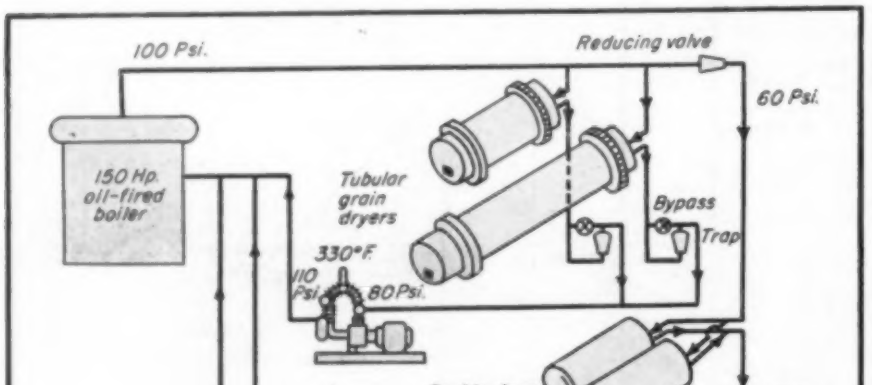
The various vents, openings, etc., were plugged with laboratory rubber stoppers inserted from the inside so that the liquid head seated them tighter instead of forcing them out. The small amount of metal exposed around one flange was doped with chemical-resistant plastic paint. A baffle inside the tank to prevent sloshing of the gasoline was cut out and discarded. A wood saw lubricated with kerosene worked nicely for cutting the rubber.

When this article was written, three months after several such tanks went into service, no leaks had occurred using a pickle of 25 percent HNO_3 and 4 percent HF at 150 to 180 deg. F.

Set on end, with the upper end cut out, the tank makes a good plating tank, but a sample should be tested with the plating solution to make sure there is no ingredient in the rubber which will leach out and change the plating characteristics of the bath.

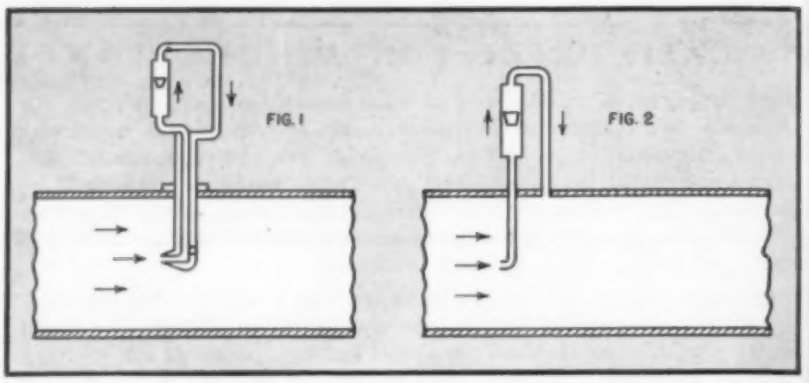


Rubber gasoline tank can be modified cheaply for plant use



High Temperature Condensate Return Speeds Drying

The diagram indicates one method in which the Cochrane C-B high pressure condensate return system has been used to increase dryer capacity, and reduce boiler requirements. The system is used by a processor of brewer's grains and high vitamin brewer's yeast. Substitution of the high pressure condensate return for the previously used open hot-well has permitted one of the two boilers formerly needed to be eliminated. Higher drying uniformity and lower costs have resulted.



Two methods of producing bypass flow through a rotameter by means of the pitot tube principle

BYPASS ROTAMETER EMPLOYS SIMPLE PITOT TUBE

FRANK GIBALDO
Consulting Engineer
Beverly, Mass.

IN THE November 1947 number of *Chem & Met* (p. 146) F. A. Mitchell described a method of using a small corrosion resisting rotameter to meter flow in a large line by using the rotameter as a bypass between the taps on either side of an orifice plate inserted in the line.

A similar result can be obtained without the use of an orifice plate by use of a pitot tube. The method indicated in Fig. 1 was used in estimating the flow of water. A regulation pitot tube was installed through a small hole drilled in the pipeline and connected to a small rotameter. The second method, indicated in Fig. 2, requires two holes to be drilled in the line. However, the inserted pipes can be fairly small so that the friction losses in the main stream are cut to the limit.

The rotameter can be situated some distance from the pipeline, but if the connections are exceptionally long the friction factor of the extension line will have to be considered.

— FROM BAGS —

— TO BARGES —

A "Chem & Met" REPORT

Bulk Packaging Of Chemicals

This month *Chemical Engineering* looks at the trend in bulk packaging of chemicals. The present situation is influenced to a great extent by the innovations that occurred during the war. Producers of many chemicals that were formerly shipped in steel drums suddenly found that there were not enough drums available to move their products. This led to a wide search for substitute containers. Among those that were developed to fill this need were improved versions of the fiber drum, textile bag, multiwall bag, and the wooden barrel. Technological advances in linings for all types of containers have placed them in a position to carry a wider variety of material. In many cases the wartime substitutes are serving well. In others there is a need for further improvement.

CHEMICAL INDUSTRY is still feeling the impact of wartime changes in packaging. Many have resulted in economy and ease in handling that were unknown before the war. These changes were first brought about by a lack of metal to meet the expanding need for bulk packaging in the chemical and other industries. As metal became critical, glass containers and tight wooden barrels were used in growing numbers, they too became scarce and still the demand for bulk packages in the chemical industry expanded. Fiberboard drums moved in to fill the gap, they were also swallowed up in the market. Paper was less critical than other materials and so multiwall bags were called upon to fill the tremendous need of chemical producers. They proved so successful that demand for them has pushed the consumption of paper in these bags up to 50,000 tons per month. More than 600 million of these sacks were used in packaging of chemicals in 1947.

There has been a rapid advancement in the field of chemical-resistant and moisture-proof liners for use in barrels, fiber drums and textile bags. These developments give all containers the same opportunities for expanding in the field of bulk packaging. They can all be made suitable for handling dry chemicals. Labor cost, filling and handling problems and storage requirements are basic determining factors in choosing the proper container.

Waterborne shipments of heavy chemicals are increasing in some sections of the country. This has created a larger use of barges in the chemical industry. Typical of the tank barges now in use, is the barge shown above as it loads at a southern chemical

FILLING open mouth bags is a rapid process at this large sugar refinery which is located on the Eastern seaboard

STORING multiwalls is no problem. Strength of the bags is shown by the load placed on the bottom layer

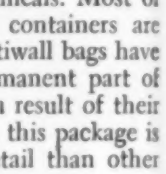
plant. Barges will offer some relief to the tank car situation which is still tight, and will cushion the effect of recent freight rate hikes.

New materials are constantly presenting new packaging problems. Radioactive compounds are an example. Recently, the ICC set up regulations for these materials. They are classified as class D poisons and are broken into three groups. Group I emits gamma rays or gamma and electrically charged corpuscular rays. Group II emits neutrons and either or both types of group I radiation. Group III emits electrically charged corpuscular rays such as alpha or beta.

A point that should not be overlooked in the postwar period is the continued shortage of steel. While the steel drum production has been steady, an increase in demand has been the principal cause for the lack of raw material. The growth in the aluminum industry has made larger quantities of this metal available for containers.

This report is designed to point out postwar trends and possibilities in bulk packaging of chemicals. Most of the old line standard containers are well known. Since multiwall bags have recently become a permanent part of the chemical story, as a result of their success during the war, this package is discussed in greater detail than other types in common use.

Multiwall Bags

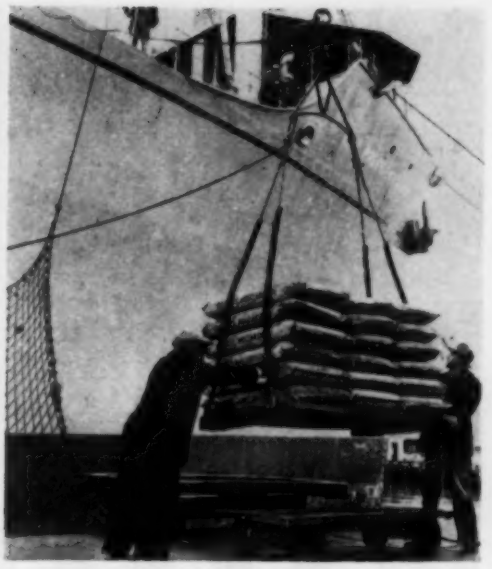


MULTIWALL paper bags are made in a variety of constructions to fit variations in contents, shipping and storage conditions. They are made from three to six plies or walls of specification paper, often in combination with special coatings or laminants.

The average heavy-duty multiwall paper shipping sack is constructed of a number of sheets ranging from 40 to 70 lb. in basis weight. When referring to paper shipping sacks, one should never confuse this type of package with the general term "paper bag, or paper sack," or its paper quality with the types of paper often used for grocery bags or wrapping purposes. Shipping sack paper must be made of long fibers properly interlaced to obtain maximum strength and durability.

Specifications for multiwall shipping sack paper have been developed by observing the performance of these containers over a long period, not only for the purpose of establishing minimum individual tests as determined by conventional and accepted methods, but with a view of keeping machine and cross machine tear, tensile and stretch in proper relation to each other for maximum results. Study of these factors was accelerated by the

HANDLING palletized loads speeds storing and makes stored material easily available. Bags are often palletized in chemical plants



LOADING shredded coconut. Multiwalls carry many chemical raw materials

overseas packing requirements that arose during World War II.

Flexibility of these containers requires special attention to the moistureproof and waterproof barriers or the special coatings that may be used to make them grease-proof, acid-proof or scuff-resistant, and coatings used in sacks for packing such commodities as synthetic rubber, asphalt, waxes and resins to prevent the paper from sticking to the material.

Five major types of multiwall paper shipping sacks are shown in Fig. 1 on page 128.

Two types of valve sacks are completely fabricated in the bag factory with a small opening left in one corner through which the sack is filled. The valve is made with an inner flap which operates as a self-closing check valve as soon as the sack has been filled. In cases where special protection is needed, extra sleeves are provided which prevent the sifting of free-flowing granular products. Note Fig. 2 (a) and 2 (d). The valve is closed in a variety of ways, all of which are simple and effective. Valve type sacks can be used only with valve packing equipment. Various types of filling machines are constructed to weigh the product to be packed and propel it through the valve into the sack. These machines vary in design and size to meet the various physical properties of materials to be handled and rate of production.

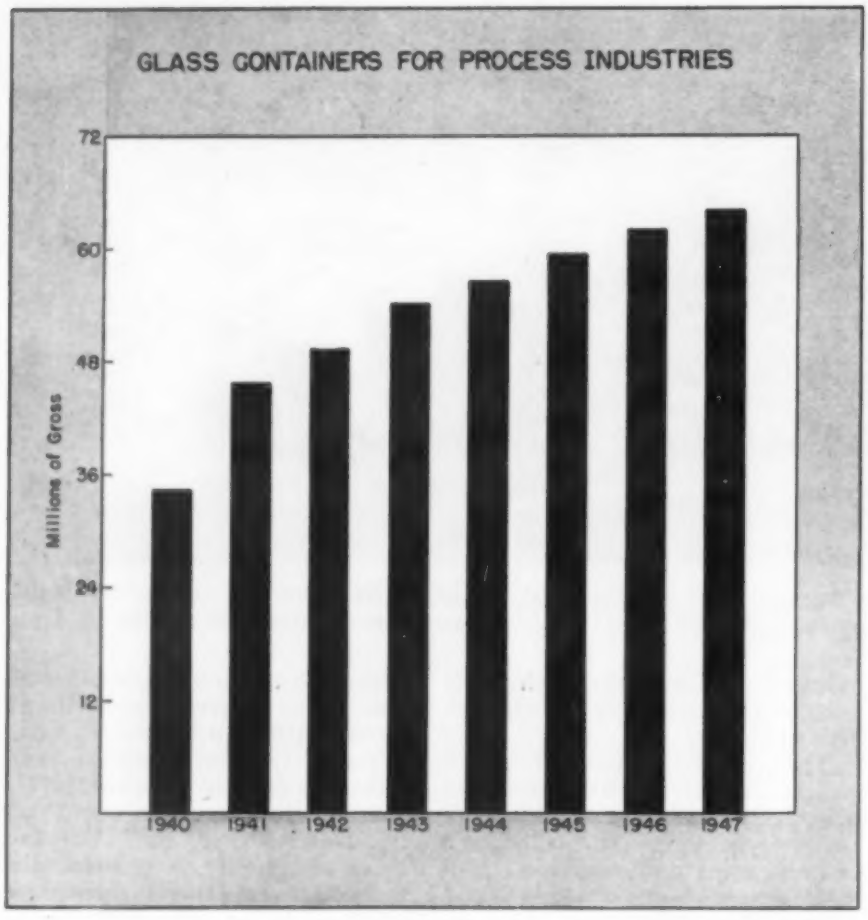
Open mouth sacks are factory closed at one end only, the other end being closed after the sack is filled, by sewing, wire tying, stapling, or by the use of gummed tape. Of these methods, sewing is the most popular and several automatic and semi-automatic machines are available which apply bound-over tape and stitch through all plies of the sack.

The open corner sack as illustrated in 1 (e) and 2 (c) is an intermediate variety between the valve and open mouth type sacks. It usually has a sewn bottom and the open top is partly closed by sewing. These sacks are often used for commodities which are liquid when poured hot, and which harden into a cake of the shape and size of the sack when they cool. Usual procedure is to place the sack in a form and flow the hot liquid in from a pipe inserted at the open corner. The plies at the open corner are brought together and stapled and the tape then is stapled over this closure for further reinforcement. Sacks are placed flat on their sides to cool and the resulting block is easy to stack and handle.

One or more of these five types of sacks are being used for the shipment of more than 300 different commodities, ranging in weights up to 100 lb. per sack; 100-lb. is the most common unit used. The weight packed per sack varies with different commodities. The number of plies, their weight and type are selected and combined—first, to insure proper strength for each commodity and shipping condition, but they also are being made to: (a) Protect contents from the absorption of atmospheric water vapor. (Examples —calcium chloride, ammonium nitrate, and quicklime.) Also prevent loss of essential moisture from sack contents. (b) Protect contents against damage by water. Special constructions have been made to successfully withstand 24-hr. submersion and have often been sprayed for much longer periods without damage to contents. (c) Prevent the escape of essential oils or flavor from within, or contamination by other products from without. (d) Prevent insect infestation which

2. VALVE TYPES

(a) Sewn valve sack with tuck-in sleeve
(b) Sewn valve sack
(c) Open corner sack
(d) Pasted valve sack with tuck-in sleeve
(e) Pasted valve sack



LABELING is required for all dangerous materials. ICC has designed this label to warn of radioactivity

is usually a troublesome problem with flour and other food products. (e) Afford protection against bacterial contamination, foreign substances and dirt. (f) Afford protection against chemical action of the commodity packed or similar action from outside materials. (g) Prevent seepage or penetration of hot liquids when packed and facilitate removing of the paper from the material when cold and solidified. (Examples—asphalt, waxes, and resins.) (h) Prevent sifting of finely ground or poisonous products. (i) Serve as shipping containers for a quantity of smaller shipping packages such as 2, 5 and 10-lb. sacks of sugar, flour, rice, beans, salt, insecticides, and many other products. (j) Resist abrasion and scuffing from coarse, sharp products within the sack and from similar action from the outside. (k) Give proper protection and facilitate the easy removal of blocks of synthetic rubber, millions of which in 75-pound size are shipped to all parts of the United States, as well as abroad. (l) Permit neat, dustless, and secure stacking to almost any height.

Aside from the papers, laminants, and coatings developed to accomplish these results, wet-strength papers, sealing compounds for sack ends, acid resistant thread, and waterproof adhesives are used as the occasion demands. These developments outlined are available for both export and domestic use.

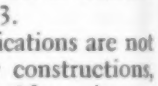
The nature of a given commodity, its reaction under varying climatic changes, the customs of handling in domestic and export shipment, are factors which must be predetermined to measure the degree and type of protection required and to enable accurate prescription of construction details of the multiwall paper shipping sack best suited for the job.

Demand for heavy duty multiwall paper shipping sacks for the packing, storage and shipment of more than one hundred different types of dry chemicals (powdered, granular, coarse, hygroscopic and non-hygroscopic) reached a total of more than six hundred million sacks in the year 1947. This represents an increase in demand of 68 percent over 1943.

In these sacks, specifications are not confined to but a few constructions, the scope is almost limitless. A producer has the privilege of obtaining any degree of protection which he considers necessary to safeguard the quality of his product in storage and in transit.

Activities of the Technical Committee of the Paper Shipping Sack Manufacturers' Association are contributing largely to the advancement of sound technical research in the paper shipping sack industry, developing greater achievement in protective packaging for American products in domestic and overseas commerce.

Glass Containers



GLASS was one of the first packaging materials used in the chemical industry. As a result of the shortage of steel in the war, the glass container business boomed. It would have gone even further in expansion except for the shortage of soda ash and fuel. The ash situation is gradually improving as alkali producers move to complete their post war expansion programs. As a result of these handicaps, the supply has been unable to meet the demand and the shortage of glass containers in 1947 was serious.

Glass containers used by the chemical process industries reached an all time high in 1947. This was in spite of the fact that total shipments of these containers fell considerably below 1946 totals. In January of this year shipments of glass containers for chemicals were 17 percent above the December figure. Shortage of steel probably will continue as a result of our European Recovery Program. This effort will tend to keep the use of glass containers at a high level.

Producers have been active in im-

HANDLING fiber drums is made simple by the use of proper material handling techniques. Fiber drums in many sizes are used to ship a wide variety of chemicals

LOADING fiber drums and wooden barrels is a common sight when chemicals move by sea. Here both types of container are stowed in a hold for shipment out of the country

proving the durability, quality, and economy of these containers in an effort to retain the fields that they have occupied as a result of wartime scarcities. One recent development concerns glass carboys. Several companies are now coating the outside of carboys to make them shatterproof.

Wooden Containers

WOODEN barrels are one of the oldest forms of chemical packaging. Barrels fall into two general classifications. These are, slack and tight. Tight barrels are, as the name implies, liquid tight. They are usually used for liquids but may be used for solids or semi-solids and heavy solids. They are made from several woods and in many sizes.

Wooden barrels staged a comeback in packaging chemicals during the war. This was the result of a shortage of steel containers. Many authorities in the chemical process industry feel that wooden barrels will not be able to stay in competition with the wide variety of metal drums and barrels except in special instances. One such exception is the whiskey barrel.

Tight barrels are suitable for packing certain chemicals although care must be taken in selecting the proper wood. Anhydrous organic chemicals tend to extract moisture from the wood and spoil both chemical and container. Penetrating liquids may also be unsuitable for shipment in barrels if shipped long distances through hot regions. Seepage may occur under these circumstances. However, some acids, formaldehyde, white oil, grease, and other chemicals may be shipped in unlined units. A number of linings are available. When the proper lining is used, many chemicals may be shipped in these containers.

Prices of wooden barrels have risen considerably and this is a real disadvantage, as the chemical industry has entered an era of economy packaging.

The structure of the modern barrel has changed very little in recent years. However, improvement in coatings and linings have made the barrel more adaptable to chemical packaging. These linings may be applied by "bunging-up" the barrel and tumbling it or by spraying the interior under pressure. Several types of coating machines are available for this job.

Wooden boxes normally consume about 15 percent of the total lumber produced in the United States. During the war this jumped to 50 percent. In 1947, boxes, crates and other wooden containers consumed 6 billion feet of lumber. About 50 percent of this total finds its way into industrial uses. Boxes have considerably improved in recent years. New methods of assembly and construction have been developed. In an effort to develop a lighter weight box, semi-nailed containers have been introduced. Lock-cornered boxes are an example. Improved nailless wooden boxes may be expected in the future. The newer types save weight, reduce wood content and permit a rapid mechanical assembly.

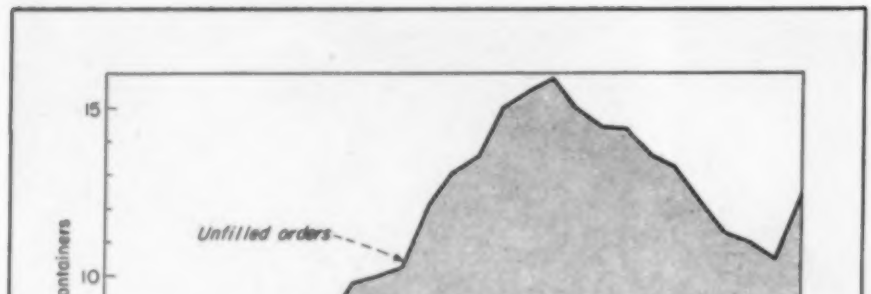
Among the major advances in production of wooden boxes are automatic joining machines, box end-making machines, hopper-fed nailing machines, and assembling machines.

Fiber Drums

POSTWAR production is nine times the prewar output—this is the record of the fiber drum industry. Output would be even higher if it were not for a raw material shortage. Steel supply situation still hampers production, but the paper board shortage is the main factor. In spite of the high rate of production these factors have kept producers from reaching capacity output.

Fiber drums have found wide application in the chemical industry in spots where a light, rigid, strong container is desired. They are constructed in a wide variety of sizes, styles and shapes. Strength of these drums can be regulated to meet individual needs. Special linings and coatings, greaseproof, waterproof, and vapor-moisture proof treatments can be supplied. Improvements in these features have made it possible to use them for some hygroscopic, delinquescent or other sensitive products. Drums with bursting strength of over 1,850 lb. per sq. in. have been developed. They can be supplied in nests. This reduces shipping costs of empty drums.

They have found wide use in the distribution of adhesives, abrasives, creams, colors, dyes, emulsions, greases, insecticides, molding powders, pharmaceuticals and fine chemicals. There are several types of fiber drums produced by each manufacturer. Each is



HEAVY STEEL DRUMS are still short. Demand for these containers has continued high. Producers still have a six-month backlog of orders

designed to serve a particular need. Some contain no wood or metal, others have wooden or metal heads or patented sealing rims.

Textile Bags

OUTLOOK for textile bags has been the subject of much study. The U. S. Department of Agriculture has completed a very comprehensive review of this situation. It estimates that in 1950 cement will use the equivalent of 6,000 bales of cotton for bags. Fertilizer will use the equivalent of 36,000. This same survey shows a trend to bulk handling exists. Cement is cited as an example. In 1943 over 42 percent of all cement was handled in bulk. Bulk handling demands a much greater outlay for equipment and packaging of the product in bags, but where it is possible to handle the materials in large homogeneous bulk quantities it sometimes gives a lower net handling cost.

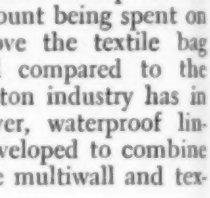
Burlap bags are old competitors of cotton but in general this competition is static at the present time. Each material has certain markets where it is preferred. Unless the price of cotton is out of line, there should be no move away from cotton to burlap for several years. While cotton has lost ground in the chemical industry it has gained in others where the salvage value is a considerable factor. During the war, multiwall bags made vast inroads in chemical industries that once used textile bags. This was the result of the acute shortage of cotton and burlap bags. They will continue to hold a large part of these wartime gains.

Cotton also benefited from the shortage of other packaging materials. There are now more than 500 different kinds of cotton bags in use. They range in size up to the 200 lb. sugar bags. Some of the new and expanded uses that cotton captured from other containers during the war have been retained.

Burlap bags are still in large demand. It is highly uncertain that the world's requirements for burlap will be met in the coming year. Partition of Bengal has cut the jute economy in two. Raw jute comes from the section controlled by Pakistan while almost the entire jute mill industry is in India. Aside from the effects of partitioning on the flow of jute to the mills, trade has been further hit by the trouble between Pakistan and India over sharing of jute export revenues.

Taking all these factors into consideration the Department of Agriculture's report on the cotton bag market indicates that they will have about the same share of the total bag market in 1950 that they held in 1945. This was about 33 percent of the total new bag market. The government report also states that the amount being spent on research to improve the textile bag is relatively small compared to the stake that the cotton industry has in its future. However, waterproof linings have been developed to combine the features of the multiwall and textile bags.

Metal Drums



METAL drums are the backbone of chemical packaging. They are still in short supply and producers have a six months backlog of orders. The postwar shortage of steel will be felt for some time because of our foreign commitments. The latest trend in metal drums is the growing use of aluminum and stainless steel in the place of mild steel. W. I. Hanrahan vice president, U. S. Steel Products Corp., recently pointed out advantages of stainless steel drums. He indicated that the cost of these containers should be figured on a cost per trip basis. They can yield a saving of over $3 per barrel per year if figured in this way. They are produced in sizes that range from 1 to 55-gal. capacities. He said that a simple steam cleaning operation renews each drum while reconditioning of other types may run from $1.50 to $4 per unit. Stainless drums have a life expectancy of 14 years. Their use has increased 500 percent above prewar levels and demand for them is expanding rapidly.

Use of improved liners in mild steel drums has increased the versatility of these containers. One of the latest studies in this field is the active research being conducted on flame sprayed polyethylene linings. The use of linings in mild steel drums will in many cases keep them in competition with more expensive contemporaries. Steel Shipping Container Institute is sponsoring a research program at Battelle Memorial Institute to develop new linings for steel containers.

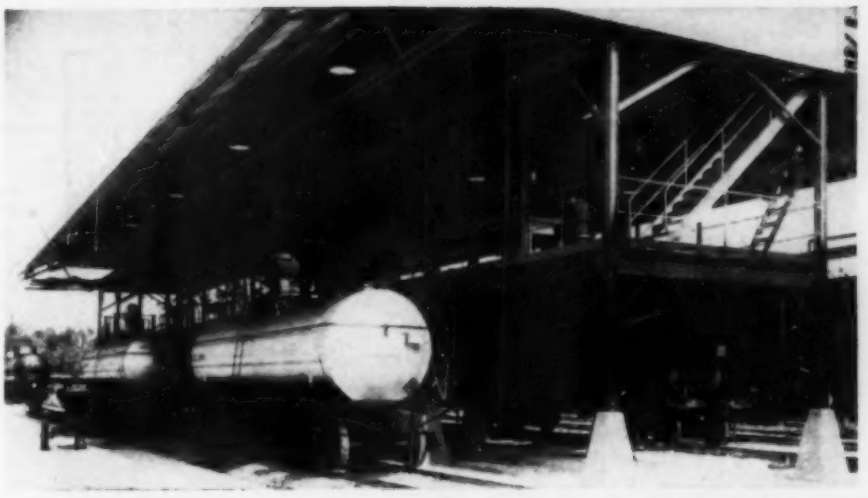
Different chemicals require different drums. The 55-gal., 18-gage, tight head drum, with two small openings is popular as a one way container for liquids. Heavy liquids and pastes use open head drums. Light steel drums

for dry materials have openings that vary from small friction covers to open head drums.

Aluminum alloy drums with a pure aluminum liner are growing in popularity in the chemical industry. This type of barrel has become quite popular in the beer industry.

Liquid peroxides other than acetyl peroxide solution and hydrogen peroxide may also be packaged in aluminum drums of not more than 15 gal. capacity, according to recent changes in ICC regulations.

Manufacturing Chemists' Association has long led in developing safe practices for handling chemicals. This group publishes specifications for various chemical containers and recommends manufacturing, marking, and inspection requirements. It also recommends additional precautionary labels to supplement those required by the ICC. The MCA has been successful in standardizing new steel drums. Their Container Standardization Committee pioneered the development of fiber drums to replace steel.



TANK CARS are the work horses of the chemical industry. Most large shipments of liquid chemicals travel in them. This platform loads several cars

Tank Cars

TANK cars are the largest containers for most tonnage liquid chemicals and compressed gases. Like all shipping containers that move by rail, they must meet ICC regulations. As a result, selection of the proper tank car for shipment of a chemical is important. The following table is presented here to show what regulations apply to a selected list of chemicals. This list is subjected to change and is offered only as a guide. It should not be used as a final authority. Complete data may be obtained from the AAR Committee on Tank Cars or the Bureau of Explosives at 30 Vesey Street, New York, N. Y. This table is based on data compiled from the ICC regulations by American Car and Foundry Co.

Among new developments in tank cars is the growing use of aluminum and stainless steel bodies. Acetic acid is one of the major organic chemicals using the aluminum car. Demand for existing aluminum tank cars is greater than that for steel. Aluminum units rent at a rate one-third higher than the rate for steel cars.

Many chemicals require a lining of the metal car to protect the quality of the product, although this may not be specified in ICC regulations. Several linings are used. In addition to glass and rubber, vinyl and phenolic resin linings have been developed to give satisfactory service. Polyethylene will also be used in the future.

CARS THAT CHEMICALS USE

Commodity	I.C.C.	I.C.C. Class. 103	Class. of Car—I.C.C. 104	105A	106A	107A	108	Class. of Car—A.A.R. 201A-35	203
Acetaldehyde	110	I.L. ‡	‡, †₄	†	...	...	...	...	...
Acetic acid		N.R. ¶	...	...	...	...	¶, ¶₄	...	...
Acetic anhydride		N.R.	...	...	...	...	...	¶	...
Acetone	110	I.L. ‡	‡, †₄	...	...	...	...	...	...
Acetyl chloride	247	C.L. ¶, ¶₄	...	...	...	...	...	...	...
Acrylonitrile	110	I.L. ‡	‡	...	...	...	...	...	...
Alcohol, or alcohol n.o.s.	104	I.L. ‡	‡	...	...	...	...	...	§
Alcohol, allyl, liquid	340	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Alcohol, denatured	104	I.L. ‡	‡	...	...	...	...	...	...
Alcohol, wood	104	I.L. ‡	‡	...	...	...	...	...	...
Alkaline caustic liquids	240	C.L. ¶, ¶₄	...	...	...	...	...	...	...
Alum, liquor		N.R. ¶₃	...	...	...	...	...	...	†RL
Aluminum acetate		N.R. ¶	...	...	...	...	...	...	†
Ammonia, anhydrous	303	N.G.	...	¶	¶	...	...	...	...
Ammonia, aqua		N.R. ¶, ¶₄	...	...	...	...	...	...	†
Ammonium nitrate solution		N.R. †, †₃	...	...	...	...	...	¶	...
Ammonium Thiocyanate liquor		N.R. ¶	...	...	...	...	...	...	†
Amyl acetate	110	I.L. ‡	‡	...	...	...	...	...	§
Amyl chloride	110	I.L. ‡	‡	...	...	...	...	...	...
Aniline oil, liquid	339	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Antimony pentachloride	247	C.L. ¶₄	...	...	...	...	...	...	...
Argon	303	N.G.	...	...	...	¶	...	...	...
Arsenic acid, liquid containing not over 0.05% nitric acid	340	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Arsenic acid, liquid containing over 0.05% nitric acid	340	P.B. ¶LL, ¶LL₄	...	...	...	...	...	...	...
Arsenic pentoxide, solid	341	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Arsenic trichloride, liquid	349	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Asphalt	116	I.L. ‡	‡	...	...	...	...	...	§
Benzene	110	I.L. ‡	‡	...	...	...	...	...	...
Benzoyl chloride	247	C.L. ¶LL₄	...	...	...	...	...	...	...
Benzyl chloride	247	C.L. ¶₄	...	...	...	...	...	...	...
Butyl acetate		N.R. ¶	...	...	...	...	...	...	†
Butyl propionate	110	I.L. ‡	‡	...	...	...	...	...	§
Calcium chloride brine		N.R. ¶	...	...	...	...	...	...	†
Carbolic acid, liquid phenol	341	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Carbolic acid, solid phenol	356	P.B. ¶, ¶₄	...	...	...	...	...	...	...
Carbon bisulphide	106	I.L. ‡	‡	...	...	...	...	...	...
Carbon dioxide, liquefied	303	N.G.	¶₄500 lb.	...	...	...	...	...	...
Carbon tetrachloride		N.R. ¶	...	...	...	...	...	...	†
Caustic potash, liquid	249	C.L. ¶, ¶₄	...	...	...	...	...	...	...
Caustic soda, liquid	249	C.L. ¶, ¶₄	...	...	...	...	...	...	...
Chlorate of soda, wet with not less than 10% water	163	O.M. ¶	...	...	...	...	...	...	...
Chlorine	303	N.G.	...	¶	¶	...	...	...	...
Chlorobenzene	110	I.L. ‡	‡	...	...	...	...	...	§
Chloronaphthalene		N.R. ¶	...	...	...	...	...	...	†

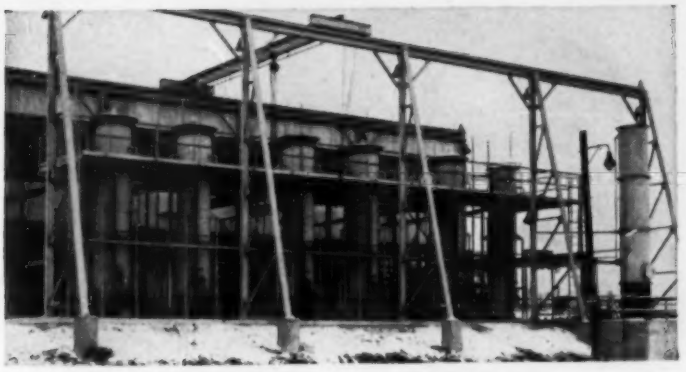
¶—Commonly used; †—May be used; ‡—Commonly used depending on vapor pressure of chemical; §—May be used if flash point of chemical is over 80 deg F. and it is not subject to I. C. C. regulations.

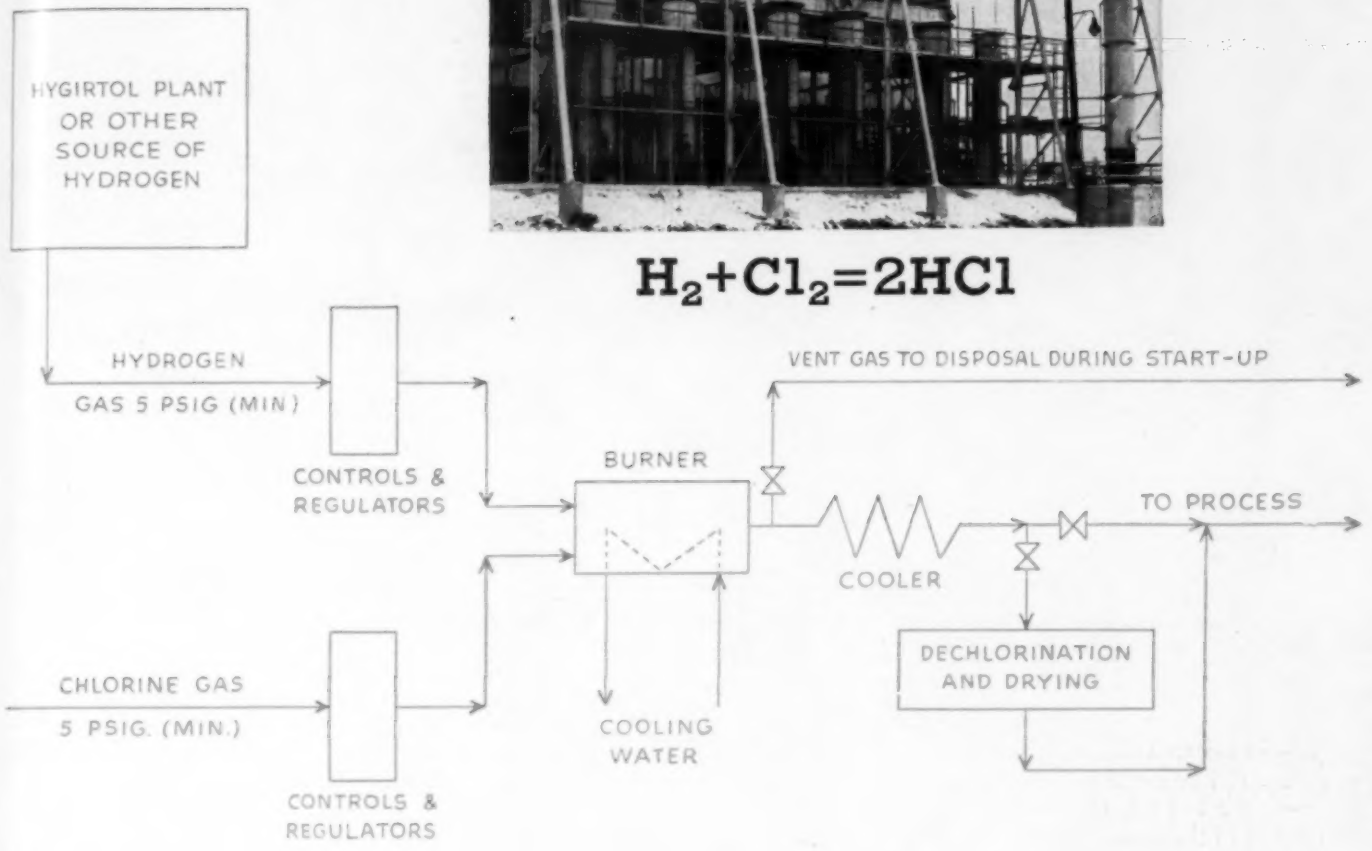
C.L.—Corrosive liquid; E. B.—Class "B" explosives; I. G.—flammable compressed gas; I. L.—flammable liquid; I. S.—flammable solid; L. L.—lead lined; N.—solid nickel; N. G.—non-flammable compressed gas; N. O. S.—not otherwise specified; N. R.—non-regulatory commodities not subject to I. C. C. but they may be of a combustible or corrosive nature; O. M.—oxidizing material; P. B.—poisonous liquid or solid, class "B"; R. L.—rubber lined; W.—welded tank.

Subscripts indicate a variation of the car design. For example; Acetyl chloride is shown as ¶₄ under the general car classification 103. This means that this chemical is commonly shipped in I. C. C. Class 103-A cars. Under the same column head formaldehyde is indicated as commonly using I. C. C. Class 103-B cars by the symbols ¶₃. Acetic acid is commonly shipped in I. C. C. Class 103. This is shown by the symbol ¶ under the column head 103.

Commodity	I.C.C.	I.C.C. Class.	103	Class. of Car—I.C.C. 104	105A	106A	107A	108	Class. of Car—A.A.R. 201A-35	203
Chloropentanes	110	I.L.	‡	‡	...	...	...	...	...	...
Chlorosulphonic acid	254	C.L.	¶A	...	...	...	...	...	...	...
Chrome chloride solution		N.R.	¶	...	...	...	...	...	...	†
Chrome sulphate solution		N.R.	¶	...	...	...	...	...	...	†
Creosote	110	I.L.	‡	‡	...	...	...	...	...	§
Cresylic acid		N.R.	¶	...	...	...	...	...	...	†
Crude nitrogen fertiliser solution	303	N.G.	.....	...	¶	¶	...	...	...	...
Crude oil, petroleum	110	I.L.	‡	‡	...	...	...	...	...	§
Cyanide, potassium, liquid	345	P.B.	¶, ¶A	...	...	...	...	...	...	...
Cyanide, sodium, liquid	345	P.B.	¶, ¶A	...	...	...	...	...	...	...
Cyclopentane	110	I.L.	‡	‡	...	...	...	...	...	...
Cyclopentane, methyl	110	I.L.	‡	‡	...	...	...	...	...	...
Diamyl phthalate		N.R.	¶	...	...	...	...	...	...	†
Dibutyl phthalate		N.R.	¶	...	...	...	...	...	...	†
Dichlorethyl ether		N.R.	¶	...	...	...	...	...	...	†
Dichlorethylene	110	I.L.	‡	‡	...	...	...	...	...	...
Dichlorobenzene		N.R.	¶	...	...	...	...	...	...	†
Dichlorodifluoromethane	303	N.G.	.....	...	¶	¶	...	...	...	...
Dichlorodiphenol-trichlorethane, (D.D.T), solutions		N.R.	¶, ¶A	...	...	...	...	...	...	†
Dichloroemethane		N.R.	¶	...	...	...	...	...	...	†
Dichloromonofluoromethane		N.R.	.....	¶A	†	†	...	...	...	...
Dichloropentanes		N.R.	¶	...	...	...	...	...	...	†
Dichlorotetrafluoroethane		N.R.	.....	¶A	†	†	...	...	...	...
Diethyl phthalate		N.R.	¶	...	...	...	...	...	...	†
Diethyl sulphate		N.R.	¶	...	...	...	...	...	...	†
Diethylamine	110	I.L.	‡	‡	...	...	...	...	...	...
Diethylene glycol		N.R.	¶	...	...	...	...	...	...	†
Dimethyl ether	303	I.G.	.....	...	¶	¶	...	...	...	...
Dimethyl phthalate		N.R.	¶	...	...	...	...	...	...	†
Dimethyl sulphate	255	C.L.	¶A	...	...	...	...	...	...	...
Dimethyl sulphide	110	I.L.	†	‡	...	...	...	...	...	...
Dimethylamine	110	I.L.	‡	‡	...	...	...	...	...	...
Dinitrobenzene, liquid	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Dinitrobenzene, solid	358	P.B.	¶, ¶A	...	...	...	...	...	...	...
Dinitrochlorbenzene, solid	361	P.B.	¶, ¶A	...	...	...	...	...	...	...
Diphenylamine		N.R.	†	...	...	...	...	...	...	¶
Dipropylene glycol		N.R.	¶	...	...	...	...	...	...	†
Ether	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl acetate	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl aldehyde	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl bromide		N.R.	.....	¶	...	...	...	...	...	...
Ethyl chloride	108	I.L.	.....	¶A	...	...	...	...	...	...
Ethyl ether	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl formate	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl methyl ketone	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl methyl ether	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl nitrate	110	I.L.	‡	‡	...	...	...	...	...	...
Ethyl nitrite	110	I.L.	‡	‡	...	...	...	...	...	...
Ethylamine	110	I.L.	‡	‡	...	...	...	...	...	...
Ethylenechlorhydrin		N.R.	¶	...	...	...	...	...	...	†
Ethylenedibromide		N.R.	¶	...	...	...	...	...	...	†
Ethylenedichloride	110	I.L.	‡	‡	...	...	...	...	...	...
Ethylene glycol		N.R.	¶	...	...	...	...	...	...	†
Ethylene oxide	109	I.L.	.....	¶A	...	...	...	...	...	...
Ferric chloride		N.R.	¶B	...	...	...	...	...	...	†RL
Fluorosulphonic acid	274	C.L.	¶A	...	...	...	...	...	...	...
Formaldehyde		N.R.	¶B	...	...	...	...	...	...	†RL
Formic acid	261	C.L.	¶WC	...	...	...	...	...	...	...
Furfural		N.R.	¶	...	...	...	...	...	...	†
Furfuryl alcohol		N.R.	¶	...	...	...	...	...	...	†
Gasoline	110	I.L.	‡	‡	...	...	...	...	...	...
Glucose		N.R.	¶	...	...	...	...	...	...	†
Glycerin		N.R.	¶	†	...	...	...	...	†	†
Helium	303	N.G.	.....	...	...	...	¶	...	...	...
Heptane	110	I.L.	‡	‡	...	...	...	...	...	...
Hydrochloric acid	263	C.L.	¶B	...	...	...	...	†, †A	...	...
Hydrofluoric acid 60% to 80% strength	264	C.L.	¶A	¶A	¶	...	...	...	...	...
Hydrofluoric acid 40% strength max.	264	C.L.	¶B	...	...	...	...	...	...	...
Hydrofluoric acid 30% strength max.	264	C.L.	.....	...	...	...	...	¶, ¶A	...	...
Hydrofluoric acid, anhydrous	264	C.L.	.....	...	¶300 lb.	..	...	...	...	...
Hydrogen	303	I.G.	.....	...	...	...	¶	...	...	...
Hydrogen peroxide 52% max.		N.R.	.....	...	...	...	...	...	¶	...
Hydrogen sulphide	303	I.G.	.....	¶600lb	¶800lb			...	...	...
Iron acetate		N.R.	¶	...	...	...	...	...	...	†
Isobutyl acetate	110	I.L.	‡	‡	...	...	...	...	...	...
Isobutyl alcohol	110	I.L.	‡	‡	...	...	...	...	...	§
Isooctane	110	I.L.	‡	‡	...	...	...	...	...	...
Isooctene	110	I.L.	‡	‡	...	...	...	...	...	...
Isopentane	110	I.L.	‡	‡	...	...	...	...	...	...
Isoprene	110	I.L.	‡	‡	...	...	...	...	...	...
Isopropanol	110	I.L.	‡	‡	...	...	...	...	...	§
Isopropyl acetate	110	I.L.	¶	‡	...	...	...	...	...	...
Isopropyl ether	110	I.L.	¶	†	...	...	...	...	...	...
Lactic acid		N.R.	¶	...	...	...	...	...	...	†
Lead silicate		N.R.	¶	...	...	...	...	...	...	†
Mercuric—potassium cyanide, aqueous	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Methyl acetate	110	I.L.	‡	‡	...	...	...	...	...	...
Methyl acetone	110	I.L.	‡	‡	...	...	...	...	...	...
Methyl bromide, liquid	346	P.B.	.....	¶A	...	¶	...	...	...	...
Methyl chloride	303	I.G.	.....	...	¶	¶	...	...	...	...
Methyl formate	110	I.L.	‡	‡	...	...	...	...	...	...
Methyl isobutyl ketone	110	I.L.	‡	‡	...	...	...	...	...	§
Methylene chloride		N.R.	¶	...	...	...	...	...	...	†
Monochlorbenzol	110	I.L.	‡	‡	...	...	...	...	...	§
Monochlorodifluoromethane	303	N.G.	.....	...	...	¶	...	...	...	...
Monochlorotetrafluoroethane	303	N.G.	.....	...	...	¶	...	...	...	...
Monofluorotrichloromethane		N.R.	.....	¶A	†	†	...	...	...	...

Commodity	I.C.C.	I.C.C. Class.	103	Class. of Car—I.C.C. 104	105A	106A	107A	108	Class. of Car—A.A.R. 201A-35	203
Naphtha	110	I.L.	‡	‡	...	...	...	...	...	§
Naphthalene		N.R.	¶	...	...	...	...	...	...	†
Nitrating acid (mixed) not less than 10% sulphuric acid	267	C.L.	¶A	...	...	...	...	...	...	...
Nitric acid—not more than 1% sulphuric and not more than 0.1% hydrochloric	268	C.L.	¶C	...	...	...	...	...	...	...
Nitrobenzene, liquid	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Nitrochlorbenzene, meta or para, solid	361	P.B.	¶, ¶A	...	...	...	...	...	...	...
Nitrochlorbenzene, ortho, liquid	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Nitrogen	303	N.G.	.....	...	...	...	¶	...	...	...
Nitrosyl chloride	303	N.G.	.....	...	¶W	...	...	...	...	...
Nitroxylol	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Oil, castor		N.R.	¶	...	...	...	...	...	...	†
Oil, coconut		N.R.	¶	...	...	...	...	...	...	†
Oil, cottonseed		N.R.	¶	...	...	...	...	...	...	†
Oil, linseed, raw or boiled		N.R.	¶	...	...	...	...	...	...	†
Oil, oiticica		N.R.	¶	...	...	...	...	...	...	†
Oil, pine		N.R.	¶	...	...	...	...	...	...	†
Oil, sesame		N.R.	¶	...	...	...	...	...	...	†
Oil, soybean		N.R.	¶	...	...	...	...	...	...	†
Oil, tall		N.R.	¶	...	...	...	...	...	...	†
Oil, tung		N.R.	¶	...	...	...	...	...	...	†
Oxalic acid solution		N.R.	¶	...	...	...	...	...	...	†
Oxygen	303	N.G.	.....	...	...	...	¶	...	...	...
Pentachlorethane		N.R.	¶	...	...	...	...	...	...	†
Pentane	110	I.L.	‡	‡	...	...	...	...	...	...
Pentane, methyl	110	I.L.	‡	‡	...	...	...	...	...	...
Perchlorethylene		N.R.	¶	...	...	...	...	...	...	†
Petroleum, crude	110	I.L.	‡	‡	...	...	...	...	...	...
Petroleum distillate	110	I.L.	‡	‡	...	...	...	...	...	§
Petroleum ether	110	I.L.	‡	‡	...	...	...	...	...	...
Petroleum naphtha	110	I.L.	‡	‡	...	...	...	...	...	§
Petroleum tar	110	I.L.	‡	‡	...	...	...	...	...	§
Phosphoric acid		N.R.	¶B	...	...	...	...	...	...	†RL
Phosphorus oxychloride	271	C.L.	¶LL-NA	...	...	...	...	...	...	...
Phosphorus trichloride	271	C.L.	¶LL-NA	...	...	...	...	...	...	...
Phosphorus, white or yellow, in water	190	I.S.	¶	...	...	...	...	...	...	...
Phthalic anhydride solution		N.R.	¶	...	...	...	...	...	...	†
Potash, caustic solution	249	C.L.	¶, ¶A	...	...	...	...	...	...	...
Potassium arsenate, solid	361	P.B.	¶, ¶A	...	...	...	...	...	...	...
Potassium arsenite, solid	361	P.B.	¶, ¶A	...	...	...	...	...	...	...
Potassium nitrate mixed (fused) with sodium nitrite	182	O.M.	¶W	...	...	...	...	...	...	...
Propionic acid		N.R.	¶	...	...	...	...	...	...	†
Propyl acetate	110	I.L.	‡	‡	...	...	...	...	...	...
Propylene dichloride	110	I.L.	‡	‡	...	...	...	...	...	§
Propylene glycol		N.R.	¶	...	...	...	...	...	...	†
Propylene oxide	110	I.L.	‡	‡	...	...	...	...	...	...
Pyridine	110	I.L.	‡	‡	...	...	...	...	...	§
Pyro sulfuryl chloride	247	C.L.	¶A	...	...	...	...	...	...	...
Pyroxylin solution	110	I.L.	‡	‡	...	...	...	...	...	...
Pyroxylin solvent, n. o. s.	110	I.L.	‡	‡	...	...	...	...	...	...
Rosin		N.R.	¶	...	...	...	...	...	...	†
Shellac, liquid	113	I.L.	‡	‡	...	...	...	...	...	...
Silicon chloride	247	C.L.	¶A	...	...	...	...	...	...	...
Soda, bichromate of		N.R.	¶	...	...	...	...	...	...	†
Soda, caustic solution	249	C.L.	¶, ¶A	...	...	...	...	...	...	...
Sodium aluminate		N.R.	¶	...	...	...	...	...	...	†
Sodium arsenate, solid	361	P.B.	¶, ¶A	...	...	...	...	...	...	...
Sodium arsenite (solution), liquid	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Sodium chromate		N.R.	¶	...	...	...	...	...	...	†
Sodium hydrosulphide		N.R.	¶	...	...	...	...	...	...	†
Sodium lactate		N.R.	¶	...	...	...	...	...	...	†
Sodium, metallic	306	I.S.	.....	...	¶	...	...	...	...	...
Sodium nitrite mixed (fused) with potassium nitrate	182	O.M.	¶W	...	...	...	...	...	...	...
Sodium phosphate, n.o.s.		N.R.	¶	...	...	...	...	...	...	†
Sodium silicate		N.R.	¶	...	...	...	...	...	...	†
Sodium stannate		N.R.	¶	...	...	...	...	...	...	†
Sodium sulphite		N.R.	¶	...	...	...	...	...	...	†
Spent mixed acid	248	C.L.	¶, ¶A	...	...	...	...	...	...	...
Spent sulphuric acid	248	C.L.	¶, ¶A	...	...	...	...	...	...	...
Styrene		N.R.	¶	...	...	...	...	...	...	†
Sulphur chloride	247	C.L.	¶A	...	...	...	...	...	...	...
Sulphur dioxide	303	N.G.	.....	...	¶	¶	...	...	...	...
Sulphur, liquid		N.R.	†	¶	...	...	...	...	...	†
Sulphuric acid, 52° Be. or greater	272	C.L.	¶A	...	...	...	...	...	...	...
Sulphuric ether	110	I.L.	¶	†	...	...	...	...	...	...
Tetrachlorethane		N.R.	¶	...	...	...	...	...	...	†
Tetrachloropentanes		N.R.	¶	...	...	...	...	...	...	†
Tetraethyl lead	347	P.B.	.....	...	¶	...	...	...	...	...
Thiocyanate liquor		N.R.	¶	...	...	...	...	...	...	...
Thionyl chloride	247	C.L.	¶A	...	...	...	...	...	...	...
Tin, tetrachloride, anhydrous	247	C.L.	.....	...	¶	...	...	...	...	...
Titanium tetrachloride	247	C.L.	¶A	...	...	...	...	...	...	...
Toluidine		N.R.	¶	...	...	...	...	...	...	†
Toluol	110	I.L.	‡	‡	...	...	...	...	...	...
Trichlorbenzene		N.R.	¶	...	...	...	...	...	...	†
Trichloroethylene		N.R.	¶	...	...	...	...	...	...	†
Trichloropentanes		N.R.	¶	...	...	...	...	...	...	†
Tricresyl phosphate		N.R.	¶	...	...	...	...	...	...	†
Triethyl phosphate		N.R.	¶	...	...	...	...	...	...	†
Trimethylamine	110	I.L.	‡	‡	...	...	...	...	...	...
Turpentine		N.R.	¶	...	...	...	...	...	...	†
Urea ammonia liquor		N.R.	¶	...	...	...	...	...	...	†
Vinyl chloride, inhibited	303	I.G.	.....	...	¶	¶	...	...	...	...
Xylidine	349	P.B.	¶, ¶A	...	...	...	...	...	...	...
Xylol	110	I.L.	‡	‡	...	...	...	...	...	§
Zinc chloride		N.R.	†, †A	...	...	...	...	...	...	¶
Zinc sulphate solution		N.R.	¶	...	...	...	...	...	...	†





Girdler's good news for everyone interested in Hydrogen Chloride production

THE Girdler Corporation has been appointed licensing agent for the hydrogen chloride manufacturing process developed by Hooker Electrochemical Company. This process produces high-purity anhydrous hydrogen chloride gas by burning hydrogen with chlorine. It has proved to be an efficient process in regard to both operating cost and maintenance, and gives uniformly good results and high production yields. Suitable designs, controls and safety features minimize problems of explosion and corrosion. Investment costs are low. The process has been operated on a full commercial scale for more than five years by Hooker and others.

Girdler's appointment makes the Hooker process available to industry faced with a growing need for hydrogen chloride.

With wide experience in gas processes of all kinds, Girdler is well equipped to build hydrogen chloride plants and everything that goes with them. Of particular importance is Girdler's work in developing and building Hygirtol Plants, which manufacture hydrogen of any desired purity at lower cost than any other means. Combined with the Hooker process, this enables Girdler to provide the over-all hydrogen chloride manufacturing set-up in a single, integrated plant.

For more information about the Hooker hydrogen chloride process—using either Hygirtol or by-product hydrogen—write to The Girdler Corporation.

Deal with Girdler regarding processes for gas manufacture, purification, separation, and dehydration. Consult Girdler about problems concerning hydrogen sulphide, hydrogen chloride, carbon monoxide, carbon dioxide, inert and controlled atmospheres, natural gas, synthesis gas, refinery gas, liquid hydrocarbons, hydrogen, nitrogen, and the production of elemental sulphur.

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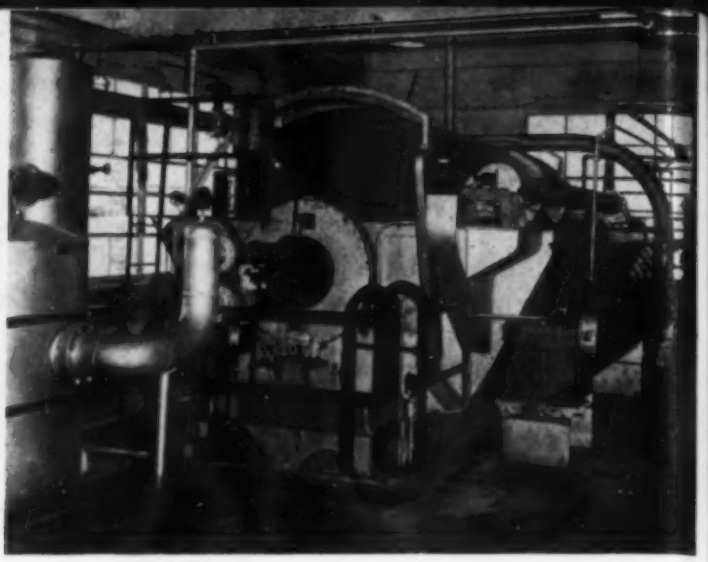
HYGIRTOL is trade mark of The Girdler Corporation

NEW $3,000,000 plant near San Jose, Calif. makes glutamate from Steffens filtrate from beet sugar factories



1 FIRST operation after weighing the incoming liquors is to pass concentrated filtrate through an Oliver precoat filter

Monosodium Glutamate

GLUTAMIC ACID, and likewise its monosodium salt, can be made in three forms. These are known as the *L* (+), *D* (−) modifications and a racemic mixture of the two in equal proportions. The latter always results from organic synthesis. The *L* (+) form of glutamic acid is the one which is always found in nature. It is produced by acid or enzymatic hydrolysis of proteins. The monosodium salt of this form when added to foods has the interesting power of bringing out their flavors. It is thus, a savoring agent or flavor accentuator. Pure monosodium glutamate itself has no flavor but has a slightly salty, sweetish taste.

Glutamic acid is one of the most common of the amino acids. Its manufacture, from natural sources, is not easy even though the process may appear relatively simple. The corrosive nature of the acid itself and also of the solutions used in its preparation introduces many complicating difficulties.

Although glutamic acid occurs in almost all proteins, relatively few source materials can be used for its commercial production. Because it is so difficult to separate glutamic from some of the other amino acids, an economical process cannot start with protein materials containing glutamic acid in small concentrations. Likewise it is uneconomic to start with materials of low protein concentrations. Accordingly the four United States producers use only the following raw materials: wheat gluten, corn gluten and Steffens filtrate resulting from the desugaring of beet-sugar molasses.

Glutamic acid is present in the sugar beet in concentrations from almost zero up to about 0.12 percent. In the raw beet, it occurs in the form of glutamine but this changes to the glutamic acid internal anhydride, known as pyrrolidone carboxylic acid, during the processing of the juice. Change of pyrrolidone carboxylic acid to glutamic acid can be effected by hydrolysis in the presence of either alkali or acid. This is in contrast to the usual alkali hydrolysis of a protein which always produces the unwanted racemic mixture of both structural forms of glutamic acid.

Shown in the accompanying flowsheet is the process now in use by International Minerals & Chemical Corp. at its new plant in San Jose, Calif. It is a modification of that originally developed and patented by Albert E. Marshall and his associates for James E. Larrowe, who founded the Amino Products Co. of Rossford, Ohio, later purchased by International.

Principal steps in the process are (1) The concentration and collection of Steffens filtrate, (2) its hydrolysis with an alkali (usually caustic soda), (3) neutralization and acidification of the hydrolysate, (4) the partial removal of inorganic salts (5) crystallization of the glutamic acid, (6) separation and purification of the latter and (7) the manufacture of monosodium glutamate from the purified glutamic acid. Monosodium glutamate is normally packed and shipped in 200-lb. fiber drums.

Reference has already been made to corrosion difficulties encountered in the process, which require the extensive use of stainless steels and rubber-lined equipment. Certain other construction materials of high-corrosion resistance have not been found satisfactory. Other difficulties are caused by great variation in the raw material due to different practices in the various beet-sugar plants and to differences in the lime used in Steffenizing the molasses. Even the genetics of the sugar beets themselves and the soils in which they are grown account for some of the variations.

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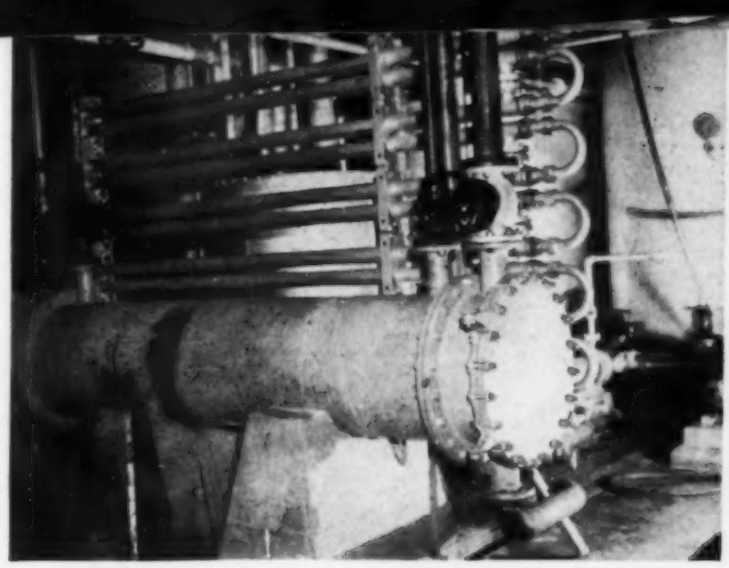
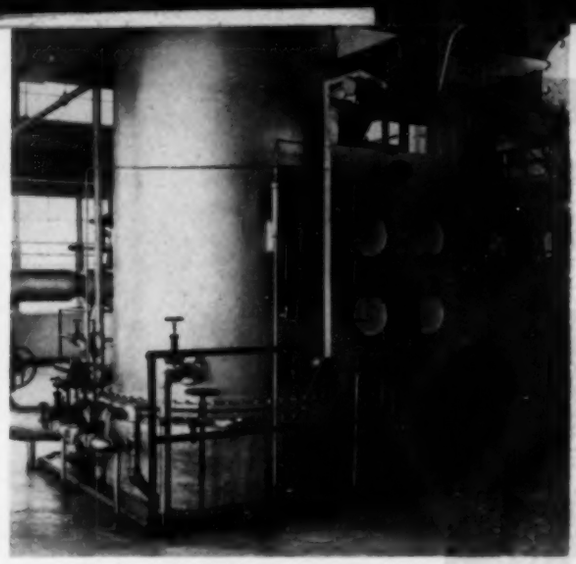
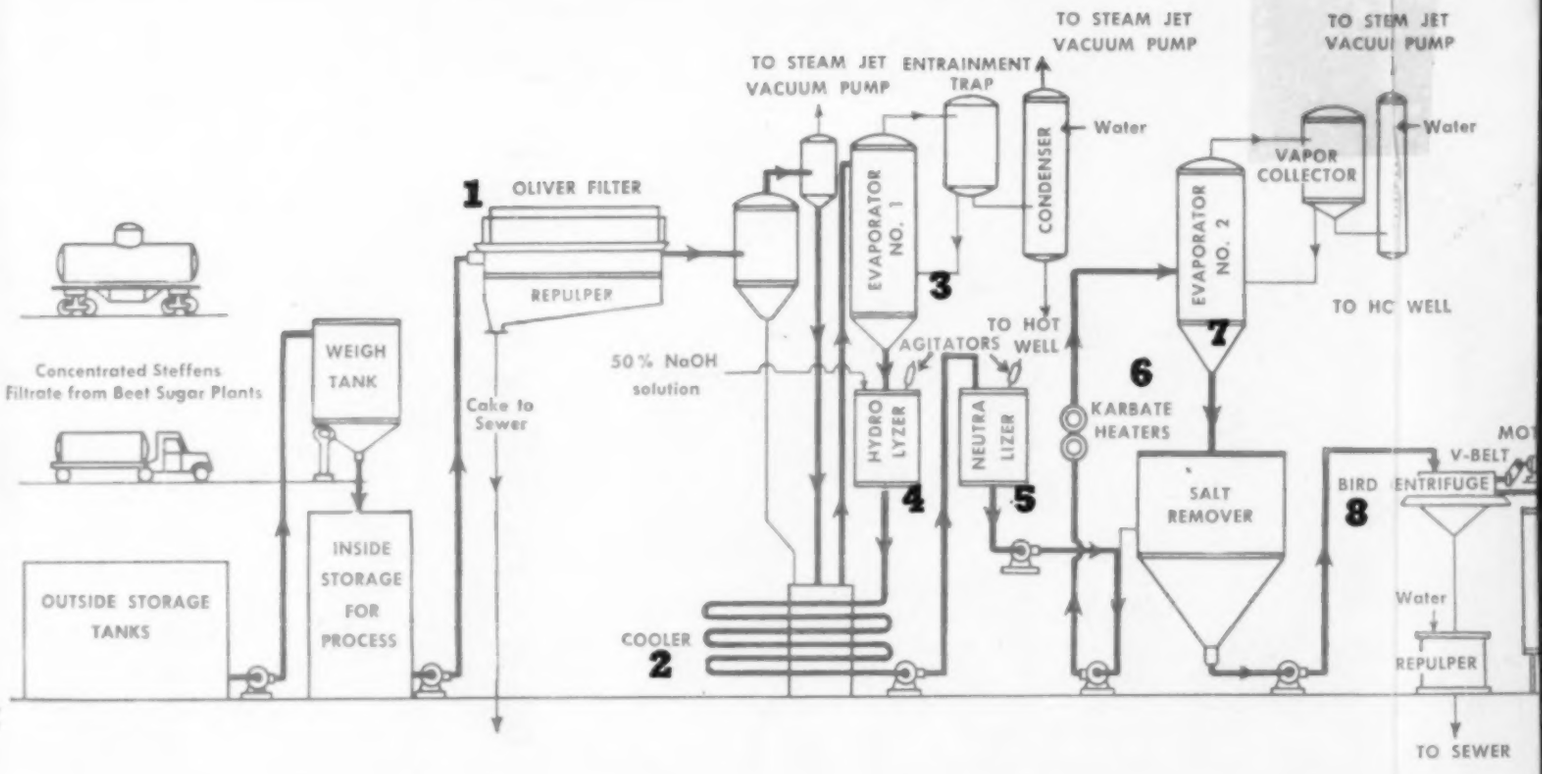


2 FILTRATE passes through Karbate heat exchanger on its way to evaporator. Plant's corrosion problems are severe

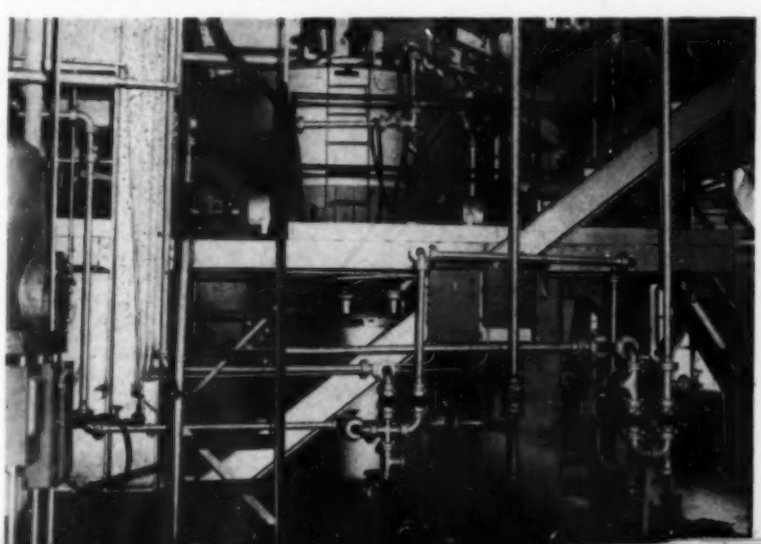


3 CONCENTRATION of filtrate is adjusted by evaporation in single effect calandria evaporator

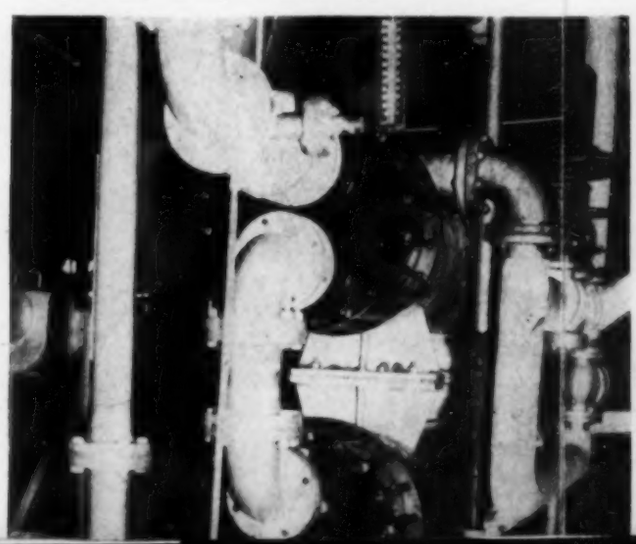
4 HYDRO
with caustic

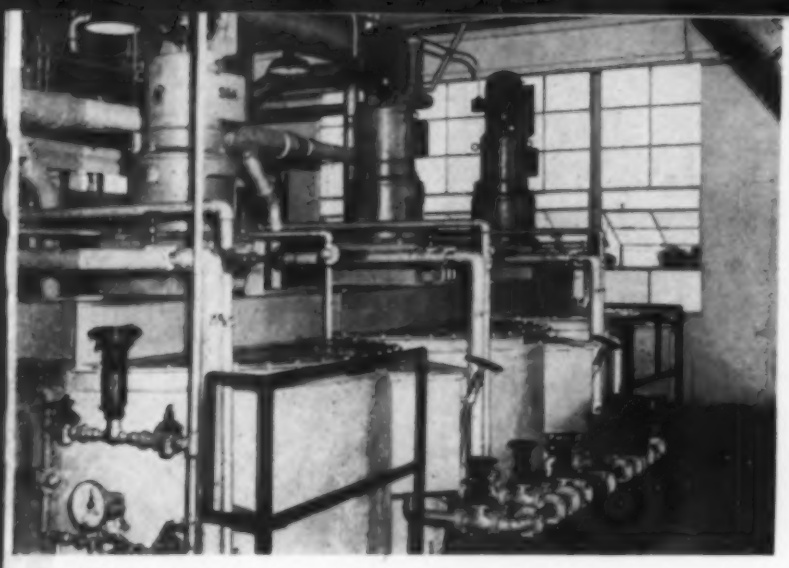


8 MINERAL salts are removed at Bird continuous centrifugal station. Then pH is adjusted to isoelectric point of glutamic acid

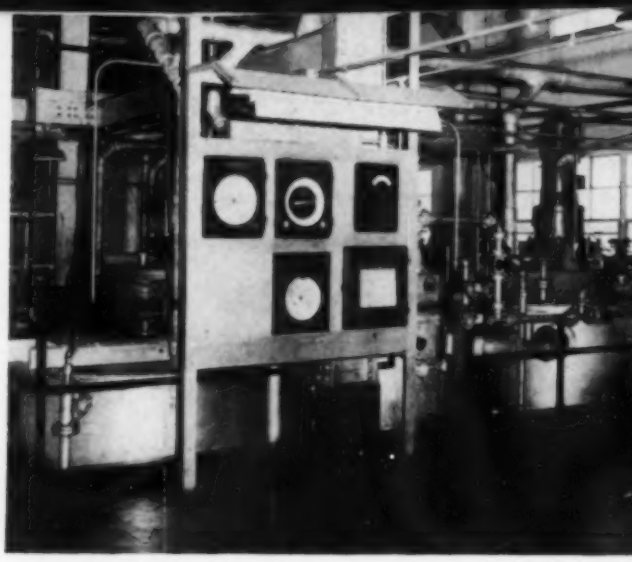


9 REFRIGERATED Karbate coolers are used for chilling the mother liquor before crystallization

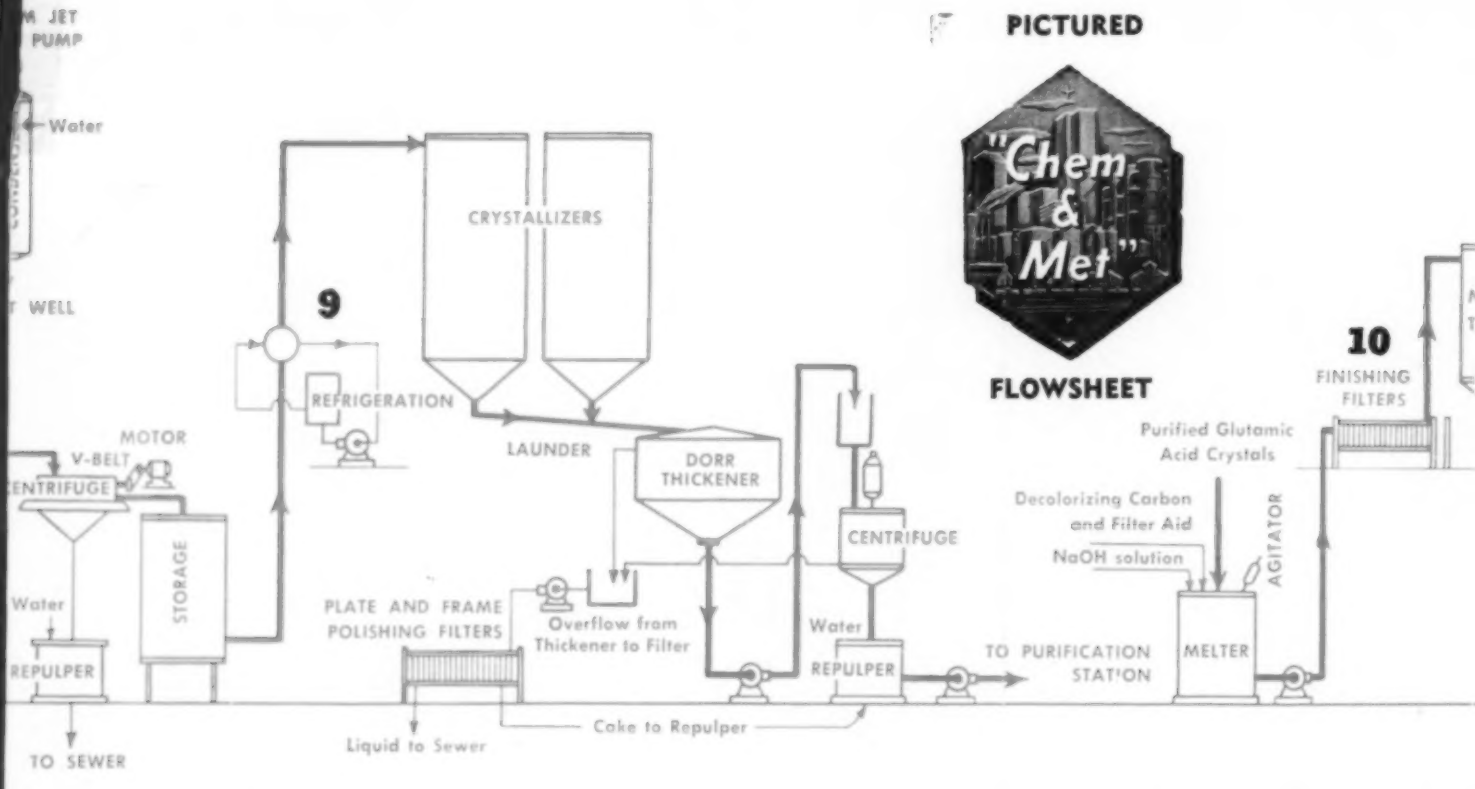




4 HYDROLYZERS are steel tanks where Steffens filtrate is mixed with caustic soda. Hydrolysis must be carefully controlled



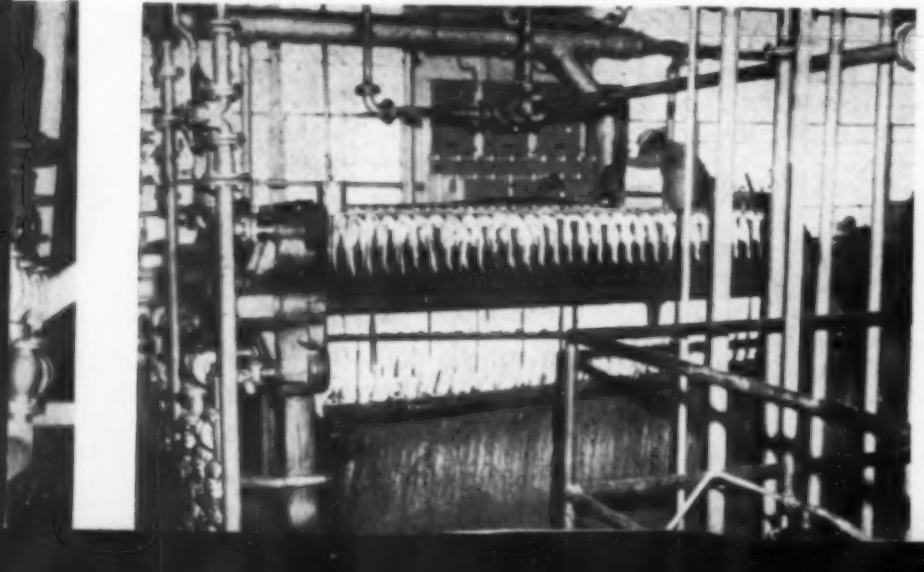
5 ACIDIFICATION with HCl forms glutamic acid in t
Instruments shown on the panel board are automatic p

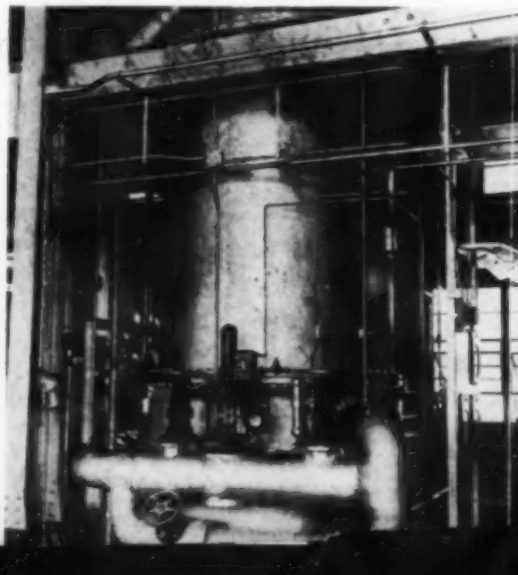


hill-

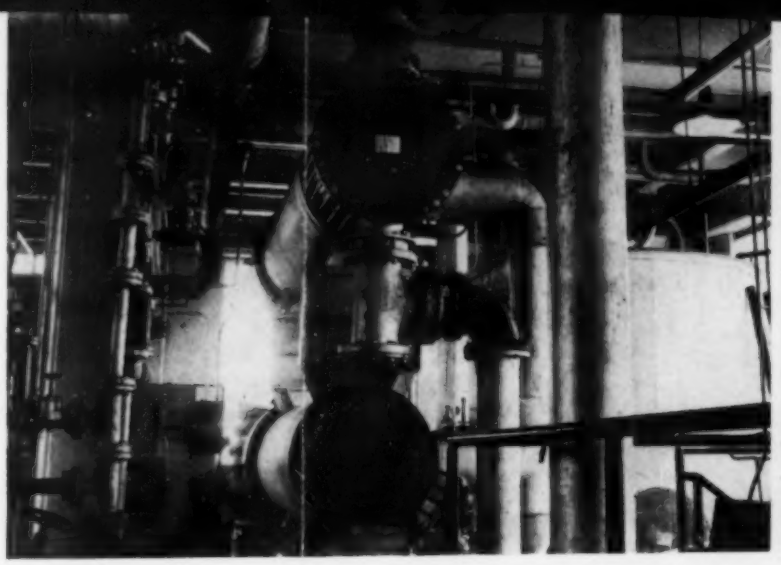
10 PURIFICATION follows crystallization. Plate and frame filter presses are used after slurry passes through thickeners and centrifugals

11 PURE monosodium glutamate is then con-
centrated in this single effect evaporator

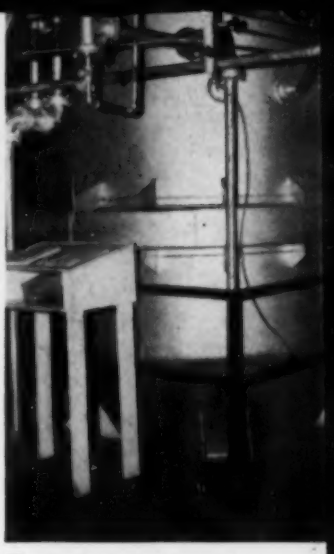




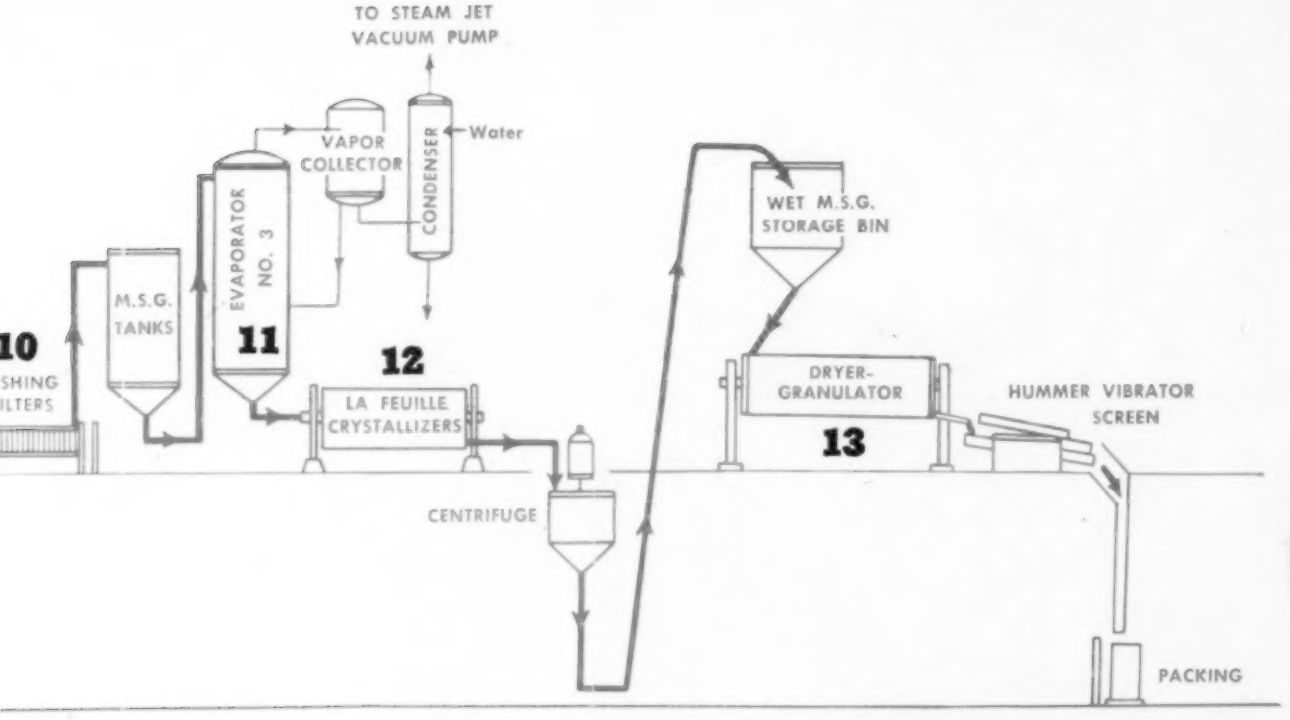
c acid in the solution. automatic pH controls



6 NEUTRAL solution is pumped through these Karbate heaters (head removed from lower unit) before passing to the evaporator

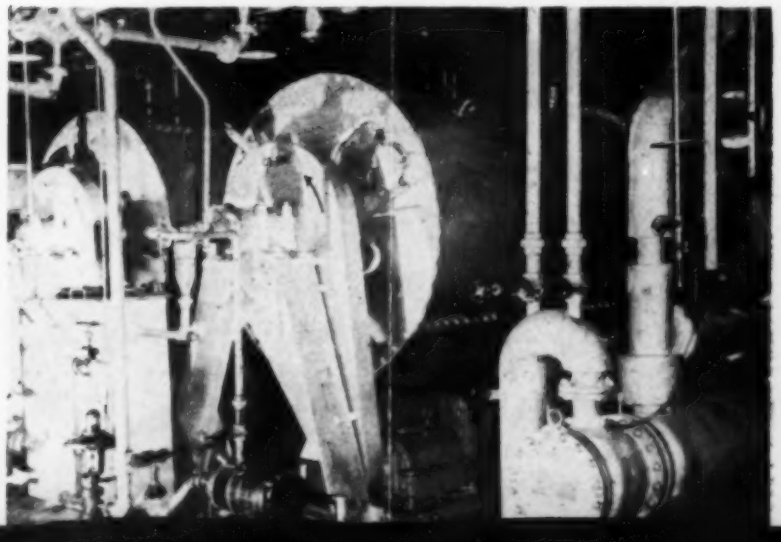


7 HYDROLYSATE is concen in this forced circulation evap



is then cen-
rator

12 GLUTAMATE crystals form in LaFeuille crystallizer. Crystallizing cycle is automatically controlled. Slurry is centrifuged



13 FINAL process steps take crystals through rotary dryer and hummer screen

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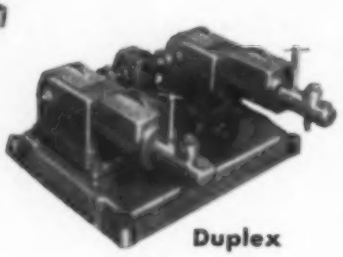
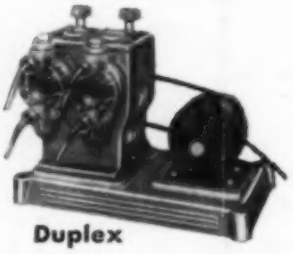
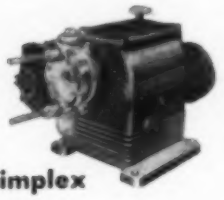


Duplex



Duplex



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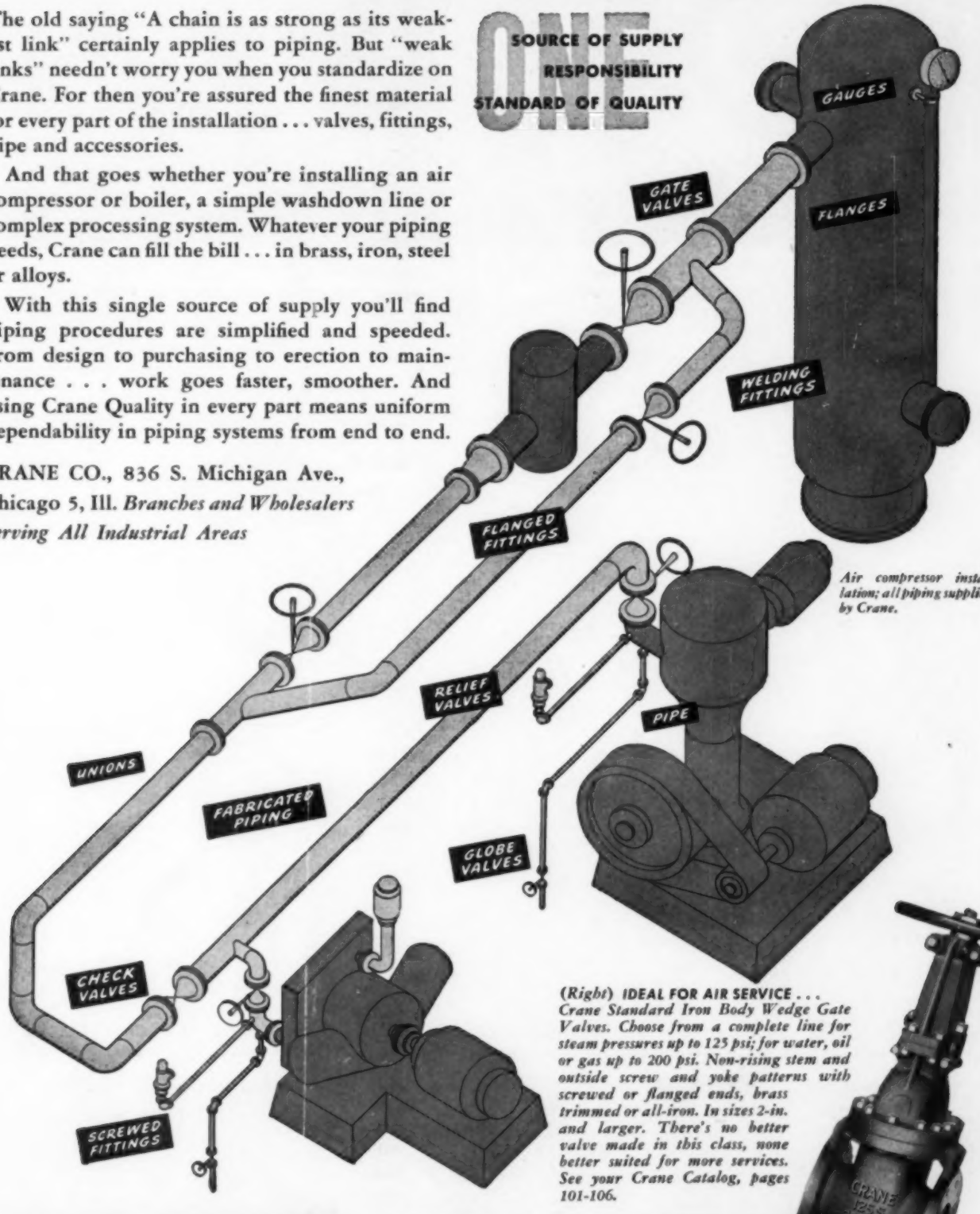

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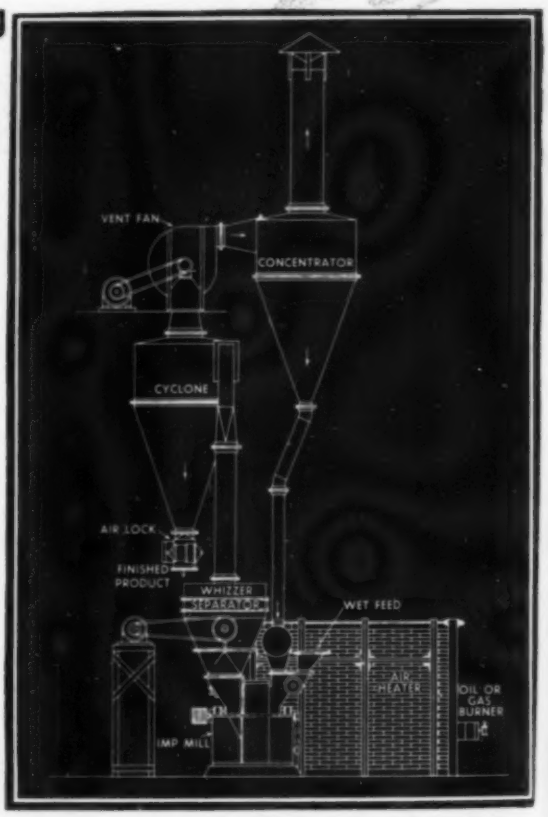

Diagram of Whizzer Type Imp Mill with Flash Drying and Fine Pulverizing

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Sales Offices in Principal Cities . . . . . Canada: Combustion Engineering Corp., Ltd., Montreal

PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR

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1. Gyratory Crusher

A NEW MODIFICATION of the gyratory principle in crushers, for which exceptionally long life is claimed, is the Kue-Ken Gyracone manufactured by the Straub Mfg. Co., 504 Chestnut St., Oakland 7, Calif. The machine requires very little headroom, its bearings are sealed and flooded

with oil and it is claimed to require less power and to crush faster and finer than earlier gyratory types. The secret of this performance is said to lie in the ability of the new crusher to crush without rubbing. This effect is secured by proper location of the apex of gyration with relation to the crushing faces. When this point is correctly located, it is claimed to be possible to crush without abrasion, by pressure alone. The mill is quickly adjusted to different sizes of products, and is provided with an instant overload release to prevent damage by tramp iron. Crusher sizes at present are 18 in. and 36 in.

2. Conveyor Idler

MATERIAL increase in the life of conveyor belts is claimed for a new adjustable troughing idler offered by Koppers Co., Pittsburgh 19, Pa. The invention of P. J. Conners of this company's engineering and construction division, the idler employs outer inclined pulleys which are adjustable from slightly above the horizontal up to an angle of 25 deg. With this arrangement the amount of trough can be adapted to the requirements of the material handled. Such idlers are particularly suited for use where an inclined belt changes to a horizontal path. They may be adjusted to form a vertical curve and provide the shallowest depth of trough necessary to retain the material without spilling. Strains on the belt can be reduced at various points by providing a suitable number of adjustable idlers to allow the belt to be troughed or flattened gradually.

FOR MORE INFORMATION
See Reader Service
Coupon on pages 159-160

3. Glass Pipe Insulation

WHAT IS claimed to be the first pipe insulation suitable for both hot and cold lines, indoors or outdoors, is the new Foamglas insulation developed by Pittsburgh Corning Corp., 632 Duquesne Way, Pittsburgh, Pa. Of cellular glass construction, the material is said to retain its insulating efficiency permanently and to be unaffected by humidity. It is claimed to be highly resistant to fumes, vapors, acid atmospheres and other elements that generally cause insulation to deteriorate. The insulation is produced in equal half sections, 18 in. long, for all sizes of pipe. It is said to be suitable for temperatures in the range from minus 200 to plus 800 deg. F. The basic material is the same as that used previously in Foamglas blocks and shapes for insulating of tanks, towers, ducts and breechings.

4. Electric Furnace Controller

TEMPERATURE control within better than 1/10 deg. F., without cycling, is claimed for a new continuous temperature control device developed by W. S. MacDonald & Co., 33 University Road, Cambridge 38, Mass. Intended for use with electrically heated apparatus, the device controls a continuous flow of power to the heating elements. It does not begin to throttle the power until the controlled apparatus comes to within 15 deg. of the set temperature, so as to permit rapid heating. The system

consists of three main elements, a Wheatstone bridge, an amplifier and a Thyratron. The temperature measuring element is a platinum resistance thermometer. The state of balance of the bridge determines the amount of power passed by the Thyratron, and hence the amount of heat provided to the furnace.

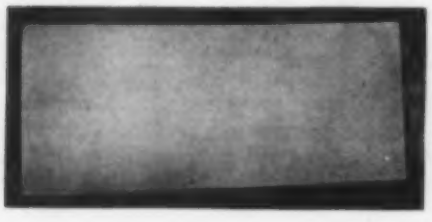
5. Solvent Vaporizer

THE Chemical Plants Division of Blaw-Knox Co., Pittsburgh, Pa., is now marketing its "Vapor Desolventizer" for plants processing soybeans. This is a heating unit which removes

residual solvent from the extracted soybean flakes at a temperature sufficiently low to prevent protein degradation. Heat is supplied to the system through the use of superheated solvent vapor, thus eliminating metallic heat-transfer surfaces. Standard sizes are available for daily capacities of 50 to 250 tons of soybeans. Multiple units are used for plants of larger than 250 tons daily capacity.

6. Plate Heater

PLATE-TYPE heating units which can be had in sizes up to 42 in. wide by 12 ft. long, claimed to give even



temperature over their entire surface up to 700 deg. F., plus or minus 2 percent, are being offered by Industrial Radiant Heat Corp., Gladstone, N. J. These heaters consume about 6 watts per sq. in. and are constructed of aluminum, nickel, chromium alloys and fiber glass. They are claimed to be particularly efficient owing to the development of infra-red rays in the longer wave lengths, and to the radiating qualities of the heating surface, which is said to act as a reflector.

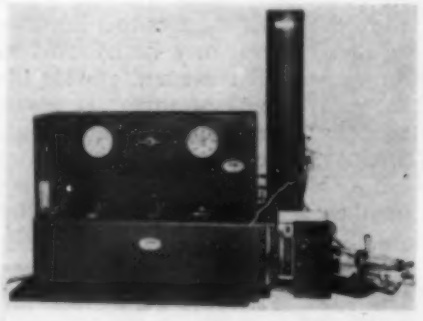
7. Mixing Conveyor

SOLID MATERIALS can be mixed in transit by means of a new type of vibrating conveyor known as the Mix-R-Step, which has been brought out by the Jeffrey Mfg. Co., Columbus, Ohio. The vibrating deck consists of a

series of stepped plates, notched at the ends, which produce a side slip as the material falls from one step to the next, thus causing intermingling of particles, together with a turnover which is partially or completely effected. This type of conveying surface is being applied to vibrating dryers and coolers and is said to be particularly effective with infrared drying.

8. Flame Photometer

OVER 30 elements, including many heavy metals and alkaline earths, can be detected and determined with a new flame photometer which is used



in conjunction with the Model DU quartz spectrophotometer produced by National Technical Laboratories, South Pasadena, Calif. Samples in solution are atomized and introduced into a hot oxygen-gas flame, exciting spectral lines which are used as the light source in the spectrophotometer proper. Operation of the photometer is simple and rapid, and precise determinations can be made on small quantities of material. Changing samples requires only a few seconds, no cleaning being necessary.

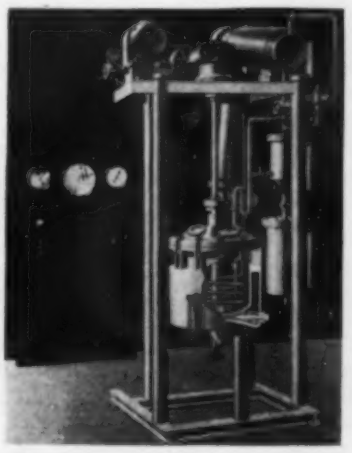
9. Multiple Drum Carrier

FROM ONE to four drums can be handled simultaneously by means of a fork truck through use of a new drum carrier manufactured by Pallet Engineering Co., 725 Second St., San Fran-

cisco 7, Calif. The carrier is attached to the truck instead of the usual fork, and employs a hydraulically operated mechanism in each of the four openings for grasping the drums.

10. Pilot Plant Unit

A COMPLETE pilot plant system featuring a 15-gal. Electro-Vapor kettle



has been announced by Blaw-Knox Co., Pittsburgh, Pa. The kettle is jacketed and heated by Dowtherm vapor produced by electric heating units in the bottom of the jacket, but it may be heated by steam up to 150 psi. pressure, if desired. Auxiliaries

How to get

THE MOST OUT OF YOUR STAINLESS STEEL EQUIPMENT

★ Getting the *best process results* along with the *longest service life* with stainless steel equipment involves more than a superficial knowledge of engineering and metallurgy.

That's why so many important companies call on Pfaudler for custom-built as well as standard stainless steel equipment. They know they can depend on Pfaudler engineering to develop the process, if necessary, but, in any case, to interpret requirements correctly at reasonable cost. They know Pfaudler controls quality from raw material to finished equipment. They know Pfaudler has *complete facilities to* do each job right, including heat treatment and passivation.

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Processes which do not permit the tolerance of metal in solution can be safely handled in Pfaudler glass-lined steel equipment. It is resistant to all acids, except hydrofluoric and commercial phosphoric.

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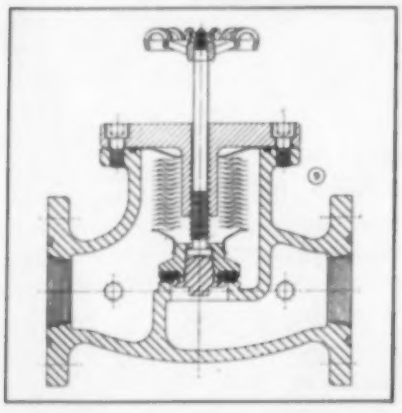
Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

include a vapor pipe, reflux and take-off condenser, condensate piping, condensate decanter and receiver, steam jet ejector and all necessary instrumentation. Construction materials have been chosen to be highly resistant to corrosion.

11. Vacuum Tight Valve

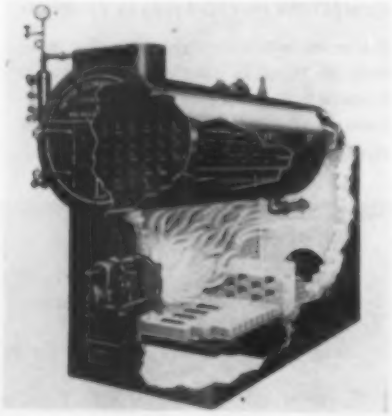
A NEW TYPE of high vacuum valve, known as Model 30, has been introduced by Kinney Mfg. Co., Boston, Mass., for use in high vacuum systems in which mercury vapor may be present, such as those involving mercury



diffusion pumps, mercury boilers or mercury arc rectifiers. In such a system, copper or bronze cannot be used and this new valve has a cast medium-carbon steel body with a stainless steel bellows, to eliminate the need for packing. The valve disk and the sealing ring between the bellows and the valve body are of silicone rubber. The valve incorporates large passages for minimum resistance to flow, especially in the molecular flow region. Sizes range from 1 to 4 in.

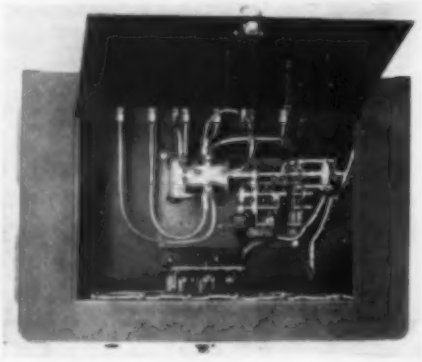
12. Steam Generator

USEFUL in these days of fuel shortages is an idea incorporated in the new package-type boiler unit recently announced by C. H. Dutton Co., 630 Gibson St., Kalamazoo, Mich. Known as the Economist Dual-Fired Steam Generator, this unit is shipped with either an oil or a gas burner and with grates for coal firing. It is claimed that the changeover from one fuel to the other can be made overnight, without loss of production time. The change is made by removing the bricking and insulation from the top of the grate when changing to a non-solid fuel.



13. Analysis Selector

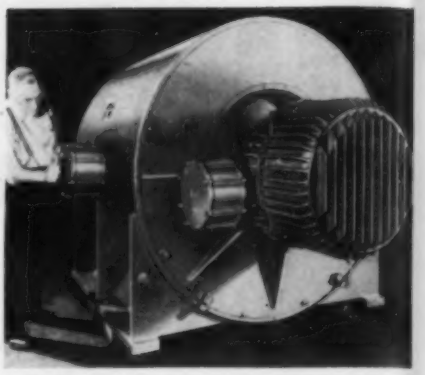
TO PERMIT the consecutive analysis of atmospheres from as many as six different sources—for example, from generators, furnaces, etc.—the Surface Combustion Corp., Toledo, Ohio, has developed a new selector for use with this company's dew point recorder. This device consists primarily of a six-way valve, a motor and an electric time clock so arranged that at a pre-set time the source of atmosphere



supply to the dew point recorder is automaticaally switched from one line to the next. In the meantime, the five remaining lines which are not feeding the recorder are continuously purged so that when the next source is to be analyzed, no time is lost in purging. Pilot lights show which source is being analyzed at any given time.

14. Fan-Cooled Motor

FOR USE on large motors operating in dusty atmospheres, Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., has developed a method of total inclosure and fan cooling that is being applied to wound-rotor motors. This construction employs an improved tube-type, air-to-air heat exchanger of high efficiency which permits a reduction in size compared to the old totally inclosed, fan-cooled type. If necessary, motors can be built with stainless steel ventilating tubes, fans and end plates, and cast-iron terminal boxes and collector-ring inclosures. The 500-hp., 750-r.p.m., 2,300-volt motor shown in the accompanying illustration is used for driving a centrifugal pump in a midwestern chemical plant. The collector assembly is cooled by radiation, with internal air circulation provided by fan blades mounted on the collector assembly.



15. Bronze Gate Valve

AVAILABLE in sizes from ¼ to 2 in. is an improved bronze gate valve designated as Fig. 270-U, that has recently been introduced by Jenkins Bros., 80 White St., New York 13, N. Y. The principal advantage is a newly designed seating combination involving a high tensile strength bronze wedge,

seating against Monel metal seat rings of hardness about 2½ times that of the valve body bronze. With this combination the wear is taken by the most accessible and inexpensive part, namely, the bronze wedge, which can be replaced when necessary by simply slipping it off the stem and slipping on a new one.

16. Impervious Graphite

A COMPLETE line of impervious graphite heat exchangers and liquid handling equipment, manufactured by Falls Industries, Inc., is being offered by General Ceramics & Steatite

Today, petroleum alone supplies about 60% of all transportation energy produced in the United States, and 99% of all lubricants. To meet the ever increasing demand for petroleum, drilling of new and deeper wells has become highly important. In drilling these wells, special chemically conditioned mud is employed to cool and lubricate the drill bit, prevent cave-ins, hold back tremendous gas pressures, and for other purposes. Many Victor* Chemicals serve as a helping hand in the conditioning of drill mud as well as in the refining of petroleum.

A Helping Hand for the PETROLEUM INDUSTRY

for 50 years
VICTOR
CHEMICALS
for everyday Living

Victor chemicals used in oil well drilling and petroleum refining include:

Sodium Acid Pyrophosphate, Sodium Tripolyphosphate, and **Tetrasodium Pyrophosphate** . . . conditioning drill mud.

Alkyl Phosphates . . . oil additives, stabilizers for gasoline.

Ferrophosphorus . . . weighting drill mud.

Phosphoric Acid . . . refining oil and gasoline.

Tripotassium Phosphate . . . purifying gasoline.

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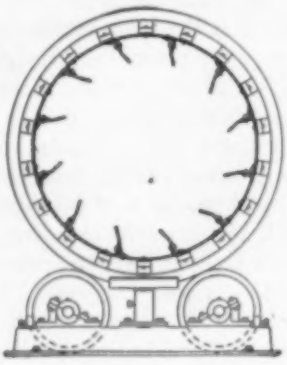
VICTOR CHEMICAL WORKS, 141 West Jackson Boulevard, Chicago 4, Illinois

HIGH TEMPERATURE DRYING



of

CRUDE ORES

and

CONCENTRATES

with

Ruggles-Coles "XF" Dryer

The Ruggles-Coles "XF" Rotary Dryer (shown above in cross section) is particularly adapted for high-temperature drying of materials of low moisture content, such as shown below. Inexpensive fuel can be used.

Crude Ores
Concentrates
Anhydrite
Barytes
Bauxite
Clay
Feldspar
Fluorspar
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See Reader Service
Coupon on pages 169-170

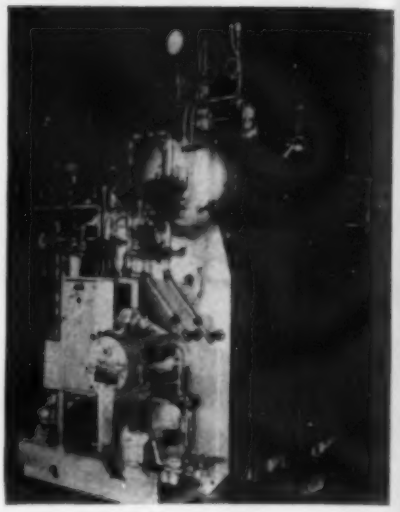
Corp., Keasbey, N. J. Included in this line are plate type heat exchangers, concentric and seven-tube heat exchangers, bayonet heaters, as well as pipes and fittings. The material is resistant to most strong acids and alkalis and has a high resistance to thermal shock, as well as high over-all thermal conductivity. It is being supplied both in combination with chemical stoneware and porcelain ware, as well as separately.

17. Augur Packer

MODEL U-1 is the designation for a new high-speed augur packer that was introduced by the Triangle Package Machinery Co., 906 North Spaulding Ave., Chicago 51, Ill., at the recent Chemical Exposition. The machine operates at speeds up to 30 packages per minute and handles quantities ranging from a few ounces to 5 lb. of dry, powder-type materials per package. The operator's only task is to place an empty container on the filling platform, all other functions of the machine being automatic.

18. Steam Generator

"PACKAGE" type steam generators in capacities up to and including 27,000 lb. per hr. are being offered by Foster Wheeler Corp., 165 Broadway, New York, N. Y. These units are assembled at the factory, including refractory and insulation, and are ready to generate steam when delivered and installed. Present designs provide for both oil and gas firing, while a coal-fired unit will shortly be on the market. At present boilers are available in two pressure ranges, up to 250 psi., and up to 850 psi. Superheaters may be had, either as original equipment or for later addition. Combustion controls are provided for full or semi-automatic operation.



19. Hand Pallet Truck

LIGHT WEIGHT and extremely novel design are combined in a new hydraulic-operated hand pallet truck, the Jack-O-Might, which is offered by Sherman Industries, Division of Sallinger-Sherman, Inc., 138 Brookline Ave., Boston 15, Mass. This truck has 2,000 lb. capacity, yet weighs only 175 lb.

20. Vibratory Grizzly Feeder

A VARIETY of sizes and styles of heavy-duty vibratory grizzly feeders

IT'S EASY to see that the size of the valve is out of proportion—but not so much if you think of *all valves* in this building as *one valve.* Collectively, valves represent an investment bigger than the cost of many large units always carefully chosen for operating economy.

That's why, today, with maintenance wages and material costs higher than ever before, alert management must keep a sharp eye on valve performance.

EXCESSIVE MAINTENANCE of one inferior valve is insignificant, but, multiplied by thousands, it becomes a serious drain on operating budgets, and often contributes to slowdowns that reduce productivity.

JENKINS BROS. helps you meet this problem two ways. First, by building extra endurance into Jenkins Valves, making them the longest-lasting, lowest-upkeep valves that money can buy. Second, with advice from Jenkins Engineers on any question of proper selection, installation, or maintenance.

For all new installations, for all replacements, rely on Jenkins quality and engineering service for lowest valve costs in the long run. *Sold through leading Industrial Distributors everywhere.*

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"PREVENT VALVE FAILURE" is a 28-page guide to valve economy, fully illustrated, with case histories of valve damage, and recommendations for its prevention by proper selection, installation, inspection, and maintenance. FREE on request. Write: JENKINS BROS., 80 White St., New York 13, N. Y.

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Types, Sizes, Pressures, Metals for Every Need

Newark TESTING SIEVES

EXACT OPENINGS

NO CREVICES

STRONG DURABLE CLOTH

CLOTH RENEWABLE

If raw material control, laboratory testing or product control in your plant calls for accurate sieve testing, Newark's Standard Testing Sieves have a definite place in your plant. Made to conform with the latest specification of the National Bureau of Standards and the American Society for Testing Materials, these sieves are extremely accurate, and, as with testing instruments of all types, accuracy is of first importance. Newark Sieves are accurate because among other things the mesh is exact and there are no crevices to catch particles.

Newark Standard Testing Sieves are available in a complete range of sizes and we shall be glad to recommend the best range of meshes for your particular requirements.

NEWARK for ACCURACY

Newark Wire Cloth COMPANY

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is now being offered by the Syntron Co., Homer City, Pa. For large capacity separation of crusher feeds, the new F-55 double-magnet type illustrated herewith is the latest addition to this company's line. These grizzlys are available with magnets mounted above or below the deck, and all feature variable control of the rate of feed.

21. Lubricated Valve

KNOWN as the Hydro-Lube, a new type of lubricated plug valve has been announced by the Pittsburgh Valve & Fittings Corp., Barberton, Ohio. The new valve is said to be the only one providing positive circulation of

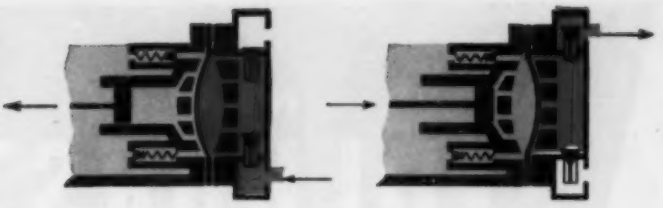
the lubricant. Every time the valve is opened or closed, all contact surfaces are lubricated by hydraulic pressure. Lubricant ducts are so arranged as never to be exposed to the line flow. The result is said to be a smaller than normal lubricant requirement, with exceptional tightness and easy working. This valve is being produced in sizes from 1 to 4 in., screwed or flanged, for 175 psi. pressure.

22. Humidifying Unit

A NEW self-contained humidifying unit capable of atomizing 35 lb. of water per hr., using 5 cfm. of air at 32 psi., has been announced by Spraying Systems Co., 4021 W. Lake St., Chicago 24, Ill. The unit consists

THE INSIDE STORY

OF CHEMICAL ISOLATION IN PROPORTIONED PUMPING



● *In the Pulsafeeder, a reciprocating piston pump displaces accurately measured volumes. But it pumps only oil or other neutral medium, which in turn actuates a diaphragm. This hydraulically-balanced diaphragm isolates fluid being handled, prevents contamination.*

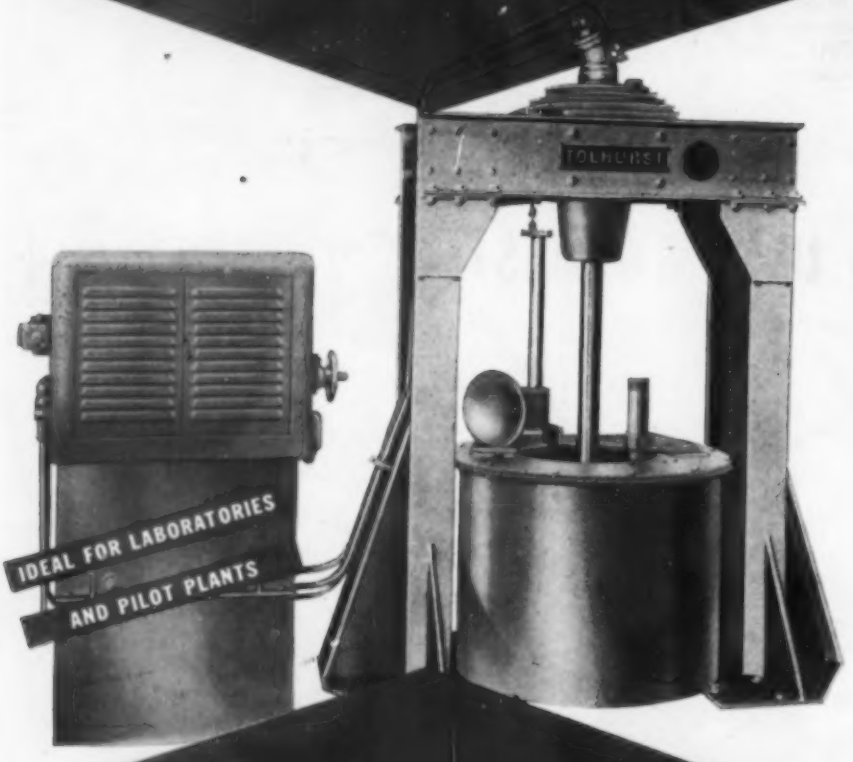
Lapp
PULSAFEEDER
PISTON-DIAPHRAGM PROPORTIONING PUMP

No other pump offers the operating advantages inherent in Lapp Pulsafeeder design. As a reciprocating piston pump, the Pulsafeeder offers the accuracy of measured-feed positive displacement and the ability to work at high pressures. As a diaphragm pump, it requires no stuffing box, offers complete isolation of chemical being handled, and consequent elimination of contamination. The diaphragm is hydraulically-balanced, so not subject to strain. Perfect lubrication for the pump is assured, with all moving parts submerged in an oil bath. Rate of flow is micro-adjustable while pump is in operation. Single-head and duplex models in four sizes for flows from less than 100 ml. per hour to 660 gallons per hour. Write for new bulletin No. 262 with complete description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 328 Maple St., Le Roy, N. Y.

Lapp *Process Equipment*

CHEMICAL PORCELAIN VALVES
PIPE • RASCHIG RINGS
PULSAFEEDER PROPORTIONING PUMPS

NEW
TOLHURST
variable speed
pilot plant centrifugal
with hydraulic drive



ONLY MACHINE of its type with variable speed hydraulic drive. Smooth, stepless speed variation from 0 to 2150 RPM. Centrifugal force range up to 1700 times gravity.

BASKETS 20" and 26" in diameter. Perforate and imperforate types available. Interchangeability of baskets made easy by drop-bottom case.

ADDITIONAL FEATURES include counterbalanced unloader and tachometer to indicate basket speed. Single speed, horizontal type motor, open, totally enclosed fan cooled or explosion-proof as specified.

LABORATORY SERVICE AVAILABLE — For confidential, unbiased and intelligent recommendations on your centrifugal problems, consult Tolhurst with its well-qualified staff and modern research facilities.

FOR SPEED AND CONVENIENCE IN

★ FILTERING
★ DRAINING SOLIDS
★ DEHYDRATING SOLIDS
★ CLARIFYING LIQUIDS
★ THICKENING SUSPENSIONS
★ SEPARATING LIQUID MIXTURES
★ SEPARATING SOLIDS SUSPENDED IN LIQUIDS

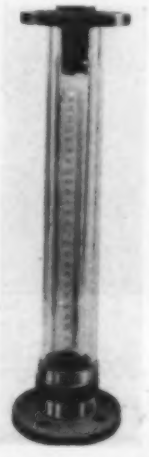
TOLHURST CENTRIFUGALS
Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS
In Canada: American Machine and Metals (Canada) Ltd., 215 St. James St. W., Montreal 1, P.Q.

FOR MORE INFORMATION
See Reader Service
Coupon on pages 159-160

of a cabinet containing the water tank, float valve, water strainer, air filter, air regulator and solenoid-operated valve. At the top four humidifying nozzles are installed. A humidistat for automatic control is also included. The spray nozzles may be individually adjusted as to direction. Any desired relative humidity is maintained automatically.

23. Chemical Rotameter

AN INEXPENSIVE pipeline rotameter primarily for chemical plant service has been announced by Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia 22, Pa. The instrument is provided with simplified end fittings and requires no stuffing boxes. This feature is possible through the use of a recently developed Corning glass flange on the rotameter tube. It may be connected directly to a standard four-hole flange, or with a companion flange, it may be connected to a threaded pipe. The rotameter tube proper is protected and covered by a Lucite tube.

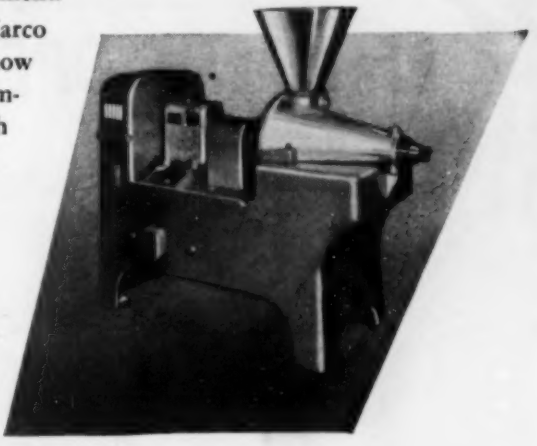


24. Reciprocating Compressors

A COMPLETELY new line of reciprocating compressors, ranging in size from 5 to 100 hp., and about one-half the size and weight of earlier machines for similar duty, has been announced by Carrier Corp., Syracuse, N. Y. Designed for either air conditioning or low-temperature duties, these compressors are so constructed that they can be assembled in more than 1,000 different combinations, making it possible to "custom-tailor"

MANY costly batch processes in the process industries can be converted into fast, efficient, low-cost continuous operations by means of the new FLOW-MASTER Roto-Feed Continuous Mixer. It will handle liquids as fluid as water, or materials heavier than viscous bread dough, mixing and discharging at a controlled rate up to 1000 GPH. Use it to feed other FLOW-MASTER units or other equipment.

If you have a mixing problem, the Marco laboratories are prepared to suggest how you can save time, lower costs, and improve the quality of your products with the FLOW-MASTER Roto-Feed Continuous Mixer.



FLOW-MASTER Roto-Feed Continuous Mixer — Capacity 5-1000 GPH. Stainless, Sanitary, Easy to Clean.

why the FLOW-MASTER ROTO-FEED is a *DIFFERENT* CONTINUOUS MIXER

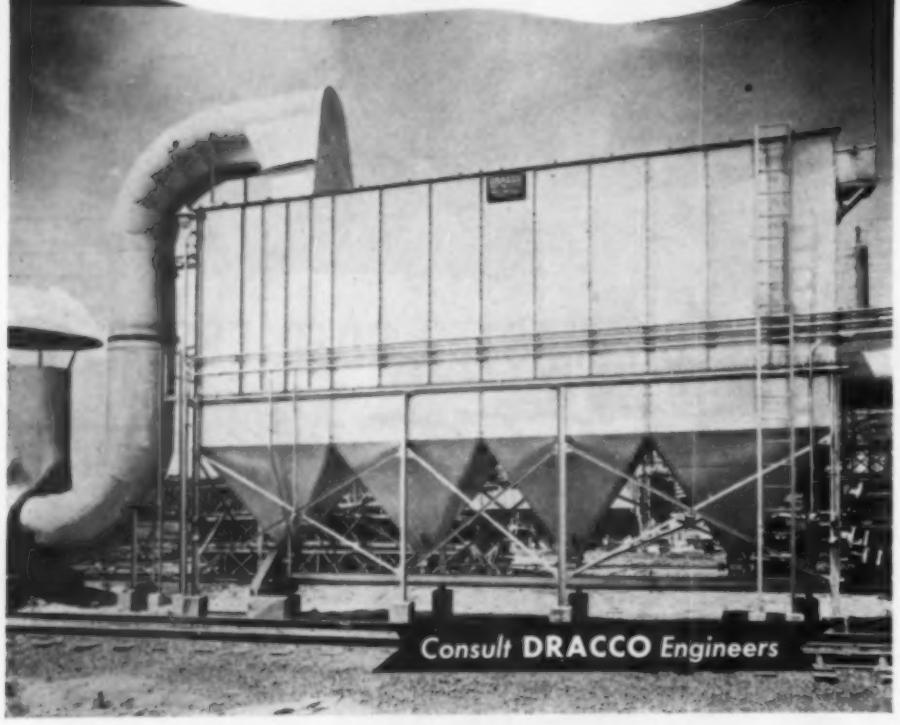
The Roto-Feed Impeller, while it resembles a worm, is really a special, unique device which combines impelling with mixing, and provides continuous delivery of a wide range of liquids or liquids containing dry additives.

MARCO CO. Inc.
10 Third Street, Wilmington 50, Del.

DRACCO DUST CONTROL

contributes to

EFFICIENT OPERATION



An outstanding fact about dust is that it ALWAYS causes a loss—an outstanding fact about DRACCO Dust Control is that it ALWAYS saves money. No matter how well a plant is managed it can't reach MAXIMUM efficiency unless it is dust-free. This is due to the fact that dust reduces efficiency in MANY ways. DRACCO Dust Control is contributing to efficient operation in thousands of plants. Why not consult DRACCO Engineers and get the benefit of their 30 years experience solving dust and fume problems of every description.

For Further Information Write

DRACCO CORPORATION

4071 E. 116th St., Cleveland 5, Ohio New York Office: 130 W. 42nd St.

DUST CONTROL EQUIPMENT

PNEUMATIC CONVEYORS • METAL FABRICATION

each complete unit to fit exact requirements for any particular installation.

25. Three-Way Valve

A SIMPLE three-way butterfly valve, costing less than specially engineered valves for this service, has been introduced by the W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn. The

valve consists of two butterfly valves and a tee, with the valves interlocked so that the closing of one vane opens the other in any proportion. Low pressure drop and low maintenance are claimed. Available sizes range from 4 to 60 in., in cast iron or special alloys, for pressures to 100 psi. and temperatures to 1,800 deg. F.

Equipment Briefs

26. A COATING said to have excellent adhesion to wet or dry surfaces, and known as Sika Seal, is available from Sika Chemical Corp., Passaic, N. J. This material, which it is claimed can even be applied under water, is said to give excellent protection to concrete, mortar, wood, steel and other metal or non-metal surfaces.

27. AN IMPROVED method for closing drums provided with bolted-type sealing rings is offered by Drum Parts, Inc., 10,311 Meech Ave., Cleveland, Ohio. The method embraces an improvement in the ring itself, and two improvements in the closing tool. It is claimed to be possible to close a drum in less than ¼ min., no skill being required. The closing apparatus has no loose parts and there are no tools to lose.

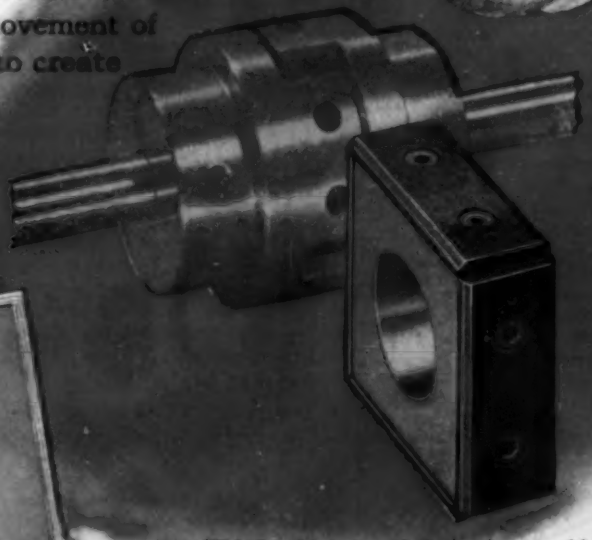
28. A DEVICE indicating temperature by color, called the "Kolor-Therm" is being produced by Kolor-Therm Indicator Corp., 434 Broadway, New York 13, N. Y. This cartridge-shaped device is yellow in color at 100 deg. F., gradually turning from orange to red as temperature increases. It again becomes yellow on cooling.

29. AN EASILY portable, motor-operated ventilating blower known as the Saf-T-Air is being offered by United Elec-

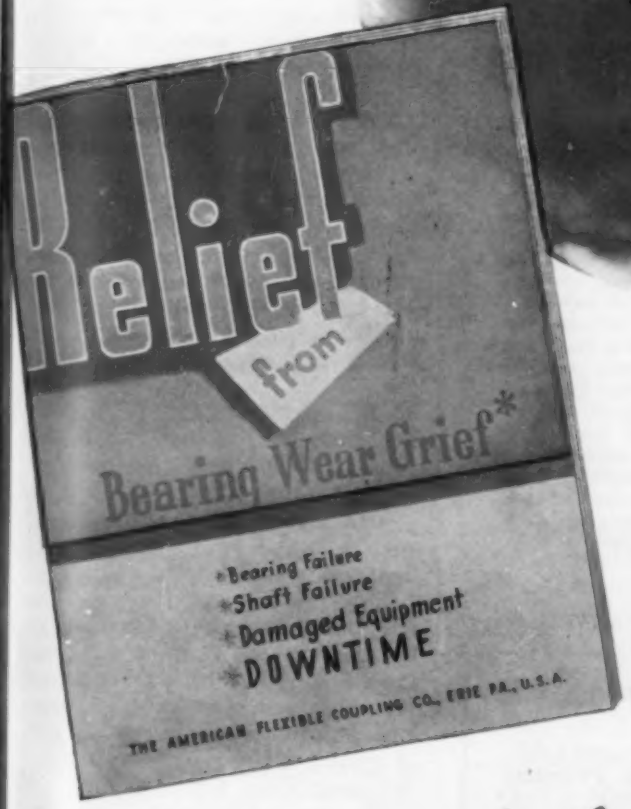
BEARING WEAR GRIEF IS A *Thief!*

It steals both time and money. Bearing Wear Grief encompasses bearing failure, shaft failure, damaged equipment, DOWNTIME.

Abnormal bearing wear will occur in the operation of a motor and driven machine connected by rotating shafts, in attempting to compensate for misalignment or relieve bending stresses through the flexure and resiliency of coupling parts, or through coupling materials in loose construction. Such methods tend to constrict free movement of misaligned rotating shafts, and to create damaging reactionary stresses.



The American Flexible Coupling relieves Bearing Wear Grief because it is designed around a Non-Flexible Floating Center Member which provides flexibility and compensates for misalignment without creating damaging reactionary stresses.



This booklet reveals how abnormal bearing wear, creating Bearing Wear Grief, eventually and inevitably results in damaged equipment and downtime. It presents practical help for the relief of Bearing Wear Grief. We believe design engineers will achieve a greater insight into the true functions of flexible couplings. Plant engineers, master mechanics, and maintenance men will definitely benefit, because herein are answers to many questions—what causes Bearing Wear Grief—bearing failure, shaft failure, damaged equipment, DOWNTIME. Write for your copy on business letterhead.

AMERICAN FLEXIBLE COUPLING COMPANY, Pittsburgh Avenue, Erie, Pa., U.S.A.
Please send me the "Relief from Bearing Wear Grief" booklet.

Name .....

Firm .....

Address .....

City ..... *State* .....

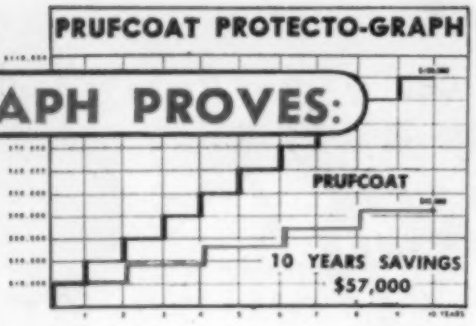
489

American

FLEXIBLE COUPLING COMPANY

PITTSBURGH AVENUE, ERIE, PA., U. S. A.
Division of J. A. ZURN Mfg. Co.

NOW PROTECTO-GRAPH PROVES:

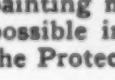


You can cut painting maintenance costs . . . *up to 70%*

Reports from plant after plant provide overwhelming evidence: Prufcoat saves 50%, 60% — even 70% — on painting maintenance. Now, to prove these amazing results are possible in *your* plant, the makers of Prufcoat have developed the Protecto-Graph Plan.

Here's how Protecto-Graph works:

Prufcoat outlasts ordinary paints as much as 10 to 1



Made from a special formulation of synthetic resins, inert pigments and volatile solvents, the Prufcoat film formed after polymerization has virtually a zero acid number, saponification number and water absorption rate. Thus, applied to floors, walls, structural steel, tanks, pipes, ducts, machinery and equipment, Prufcoat air-dries to a tough, non-oxidizing, completely acid, alkali, alcohol, oil, water and flame-proof protective coating. That's why, in the presence of strong acids and caustics, some of America's largest industrial plants report that Prufcoat outlasts ordinary paints as much as 10 to 1.

Upon request, Prufcoat Laboratories will send you a complete Protecto-Graph plan which includes a Protecto-Graph Analysis Sheet plus a sample typical Protecto-Graph. Using your own information, fill out and return the Analysis Sheet. Prufcoat Engineers will then plot a graph showing the cost of painting by your present method compared to the cost of doing the *same* job with Prufcoat. You'll be amazed to see the savings Prufcoat makes possible. So don't delay — get proof — get your Prufcoat Protecto-Graph Plan — clip and mail the coupon below *today*.

Performance-proved

"Plating department ducts that formerly corroded out and had to be replaced every few months are in good condition after three years of service."

"Prufcoat on concrete columns and walls in muriatic acid manufacturing room still in sound condition after five years — formerly repaired and repainted every few months."

"Prufcoat on cement floors, tanks, pipes, machinery and structural steel subject to acids and caustics — painting maintenance costs reduced 70%."

Send for your FREE Protecto-Graph Plan today.

PRUFCOAT PROTECTIVE COATING

Seven attractive colors that apply like paint to metal, masonry wood.

Saves more . . . because it protects more

Prufcoat Laboratories, Inc.
63 Main Street, Cambridge, Mass.

Gentlemen:

I want *proof* that Prufcoat cuts painting costs — please send me a Protecto-Graph Plan.

Name .....

Address .....

City..... Zone..... State.....

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

tric Motor Co., 178 Centre St., New York 13, N. Y., for providing air to men working in confined spaces. The unit weighs only 50 lb., but provides a capacity of 425 cfm., acting either as a blower or as an exhauster.

30. EASY RE-SETTING is a particular feature of the new dial thermometer announced by Precision Thermometer & Instrument Co., 1403 Brandywine St., Philadelphia 30, Pa. Adjustment of both dial and pointer to any point within a full 360 deg. circle may be made from the front while the instrument is in service. The sensitive element is of the bimetallic type, available in 11 standard scales from minus 100 to plus 850 deg. F.

31. A RECENT addition to its line of power-driven, hand-guided fork trucks is the Jackstacker, introduced by Lewis-Shepard Products, Inc., 285 Walnut St., Watertown 72, Mass. The machine can handle platforms or pallets up to 4,000 lb. weight, and combines the functions of a fork lift truck and fork stacker.

32. AIR VELOCITIES as low as 5 ft. per min. can be measured accurately, it is claimed, with an improved air velocity meter, announced by the Hastings Instrument Co., P. O. Box 1275, Hampton, Va. The sensitive element is a noble metal thermopile. The instrument operates directly from a 110 volt a.c. outlet or from a portable battery-operated power pack.

33. B. F. GOODRICH Co., Akron, Ohio, has announced a new hot-material conveyor belt using glass fabric instead of cotton fabric. The new construction results in increased resistance to loss of carcass strength under high temperatures.

34. THE MULTIFORM GRADER, produced for several years by the Exolon Co., Tonawanda, N. Y., has recently been improved in a number of particulars. This multi-deck screen is capable of separating dry granular materials in the range from 4 to 250 mesh. All of the screens vibrate as a unit so that the action of each sieve is identical with the others. A uniform, even flow of materials is said to be assured, with every square inch of screen surface fully utilized.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

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51. Non-Toxic Insect Killer

ONE of the disadvantages in the use of DDT and many other insecticides is the fact that they are toxic to warm-blooded animals. Overcoming this difficulty, but possessing powerful insecticidal qualities, a methoxychlor insecticide is now available from the E. I. du Pont de Nemours & Co., Wilmington 98, Del. This new insecticide with the brand name of Marlate contains methoxychlor as its active ingredient. Methoxychlor, sometimes known also as bis (methoxyphenyl) trichloroethane will kill a wide variety of insects that come in contact with it, or that eat it. Residual or lasting qualities are good and it is claimed that the new insecticide has a faster knock-down or paralytic action than DDT. It may be used either as a dust or spray and is compatible with most commonly used fungicides and insecticides. It can be freely used on livestock and on crops where certain toxic residues would be undesirable. Specifically, Marlate is recommended for use on Japanese beetles, rose chafer, asparagus beetles, cockroach, codling moths, Colorado potato beetle, corn earworm, cucumber beetles, flea beetles, house flies, hornflies, cabbage worms, melon worms, Mexican bean beetles, and a variety of other insects.

52. Ethylene Thiourea

RECENTLY introduced in pilot plant quantities by the Rohm & Haas Co., West Washington Sq., Philadelphia, ethylene thiourea is expected to be of interest as an intermediate for organic synthesis and in applications taking advantage of its salt-forming properties with metals. Known also as 2–imidazolidinethione, this material has a melting point of 203-204 deg. C. and is soluble in water to the extent of 2 percent at 30 deg. C., 9 percent at 60 deg. C., and 44 percent at 90 deg. C. It is moderately soluble in methanol, ethanol, ethylene glycol and pyridine but insoluble in most other solvents.

Reactions of ethylene thiourea usually involve the tautomeric isothiourea form and include alkylation, preparation of 2–aminoimidazolines, oxidation to sulphides or sulfinic acid, formation of methylol derivaties and acylation.

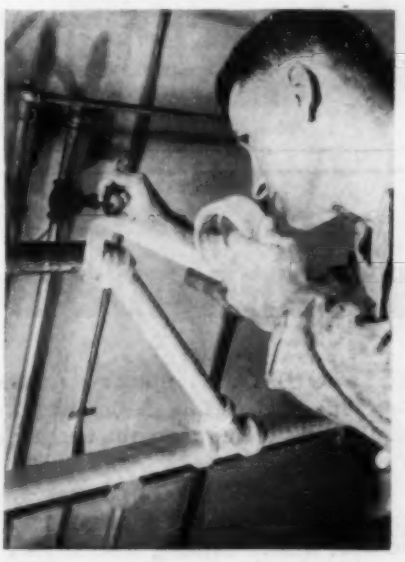
53. British Textile Dye

RESULTING from some ten years of research, a new textile dye has been announced by the Imperial Chemical Industries Ltd., Dyestuffs Division, Manchester, England. Given the name Alcian Blue, this new fast water soluble dye is said to be especially useful for textile printing. Alcian Blue gives a bright turquoise shade not previously obtainable in a dye possessing good all-around fastness to washing and to light, comparable to vat dyes. The new dye may be printed readily on fabrics made from all of the principal fibers, both natural and synthetic. However, it is particularly adaptable to cotton fabrics. The various shades of blue are available in the new dye which is now being produced in quantity at several of this company's manufacturing plants. Marketing arrangements are now being studied by the manufacturer.

FOR MORE INFORMATION
See Reader Service
Coupon on pages 159-160

54. Pressure Sensitive Tape

Now distributed nationally, a new vinyl plastic pressure-sensitive tape was recently announced by the Minnesota Mining and Manufacturing Co., 900 Fauquier Ave., St. Paul 6. Minn. This new tape is claimed to have high



stretch and good corrosion resistance to acids, alkalis, water, salt water, alcohol, aliphatic hydrocarbons and other materials. It is soluble in ketones and certain esters.

This new tape is made in 36-yd. length with widths from ½ to 22 in., and a thickness of 7 mills. Elongation at break is 175 percent. The tape is suggested for use in the chemical industry to protect metal pipes, fittings and equipment against corrosive fumes and acids, to seal rubber tubing and desiccators and for temporary repairs. It has the brand name of Scotch Plastic Film Tape.

55. Antihistamine Drug

USED to give relief to sufferers of hay fever, and other allergies, is a new anti-

YOU'RE ALWAYS SURE
With A LIQUIDOMETER
Tank Gauge

WRITE for COMPLETE DETAILS

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
36-29 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.

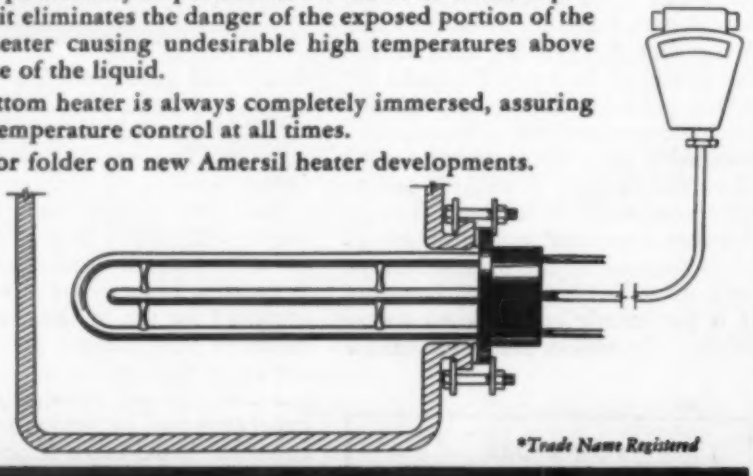
A Better Way
TO PROVIDE BOTTOM HEATING

BY EQUIPPING the new Amersil* opaque fused quartz electric heater with a special high temperature acid-proof resilient head, to effect a liquid-tight connection, the heating element may be located at the bottom of a vessel or tank.

This is particularly important where the level of the liquid varies, as it eliminates the danger of the exposed portion of the vertical heater causing undesirable high temperatures above the surface of the liquid.

The bottom heater is always completely immersed, assuring accurate temperature control at all times.

Write for folder on new Amersil heater developments.



*Trade Name Registered

AMERSIL COMPANY Inc.
ENGELHARD
CHESTNUT AVENUE HILLSIDE 5, N. J.

histaminic drug, sold under the trade name Neo-Antergan. Manufactured by Merck & Co., Inc., Rahway, N. J. this new product is supplied in sugar-coated tablets of 25 and 50 mg. The tablets are packed in handy sanitary plastic strip, ten tablets each, 100 tablets to the box. Experimental work indicated that Neo-Antergan possesses a wide margin of safety and low toxicity.

56. Acrylic Elastomer

Now in semi-works production, a new synthetic rubber is available from the B. F. Goodrich Chemical Co., Rose Building, Cleveland 15, Ohio. Consisting of a polyacrylic ester, and known by the brand name of Hycar P. A., this material resembles natural, pale crepe rubber in appearance. Available in both dry and latex forms, this material in the unvulcanized state is expected to find applications as an adhesive and as a coating or impregnant for fabrics and papers. The vulcanized form Hycar P. A. has high resistance to heat, oils, ultra violet light, ozone and gas diffusions, while non-rigid compounds show extremely good flexing life.

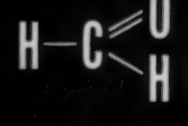
Compounding, molding, extruding, calendering and curing operations are accomplished with standard rubber processing equipment. Vulcanized products have shown good performance as heat-resistant coatings on fabrics, heat and oil resistant gaskets, hose, belting, oil seals and other mechanical applications. Having good insulating properties, it is also suggested for use as a coating on electric motor coils and as a heat and oil resistant jacket for wire.

57. Phenolic Resins

SEVERAL new phenolic resin products have recently been announced by the General Electric Co.'s Chemical Department, Pittsfield, Mass. The first group of compounds are phenolic liquid resins. These are identified as grades Nos. 12300, 12302, 12303, and 12304. These resins are all thermosetting plastics that condense on heating to form insoluble infusible materials useful in a variety of laminating, impregnating, and binding applications. Each of these resins has special fields of applications—for instance 12300 may be used for the beater addition for machine impregnation of paper, while grade No. 12302 is recommended for the production of odorless laminates such as refrigerator door liners, breaker strips and milk processing equipment.

A second class of compounds are the phenolic resin varnishes for use where

HEYDEN FORMALDEHYDE



PUTS THE PLUS + IN YOUR PROCESS!*

Ever since its discovery in 1867, formaldehyde has been doing strange and vitally important things in the industrial and scientific world. A chemical "jack-of-all trades", formaldehyde's uses range from fumigation to fabrics, photography to protective coatings, biology to bombs, disinfectants to dyes.

Heyden Formaldehyde is extensively used today in the formulation of phenol formaldehyde resins for the plastics industry—for molding and casting compounds, and for adhesives.

The chemical and process industries use Heyden formaldehyde for manufacture of polyhydric alcohols—for increasing the wet strength of paper—for making better paints, lacquers and kindred products—for production of urea and melamine formaldehyde resins, for glazing chintz, for crease resistance of fabrics, and for wool stabilization against shrinkage.

Formaldehyde Heyden **is a clear, colorless liquid, low in acid, ash and metal content. Produced under rigid laboratory control to assure uniform yields and high quality, it is available as Formaldehyde Solution U. S. P., with formaldehyde content not less than 37% by weight. Also obtainable in methanol-free grade.**

Shipped in tank cars, drums, barrels, kegs, carboys and bottles—or tank trucks in the New York metropolitan area only.

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HEXAMETHYLENETETRAMINE

Technical Bulletins on the use and handling of Formaldehyde and its derivatives are mailed promptly on request.

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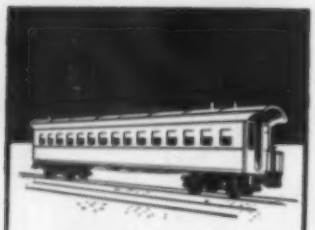
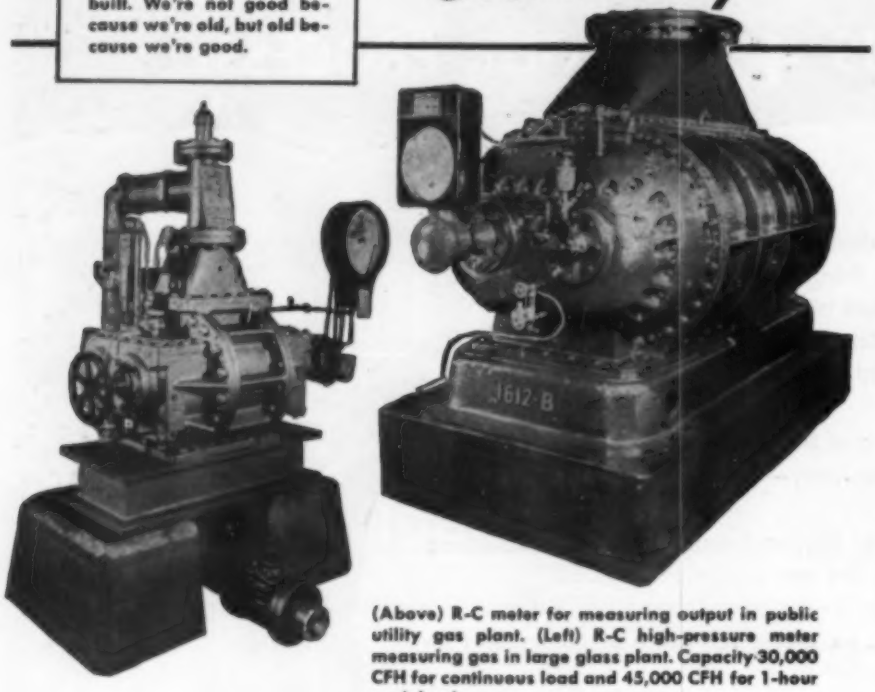


George M. Pullman's first sleeping car went into service in 1859, five years after the first Roots Blower was built. We're not good because we're old, but old because we're good.

Measure INPUT OR OUTPUT WITH "CASH REGISTER" Accuracy



(Above) R-C meter for measuring output in public utility gas plant. (Left) R-C high-pressure meter measuring gas in large glass plant. Capacity 30,000 CFH for continuous load and 45,000 CFH for 1-hour peak load.

Wherever gas needs to be measured . . . for buying, selling or processing . . . you get unfailing accuracy from R-C Positive Displacement Meters. The reasons are:

1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture or impurities.
2. Accuracy does not depend on uncontrollable factors.
3. Accuracy is not subject to adjustment of meter or recorder by operators.
4. Accuracy is not affected by reasonable overloads.
5. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast-iron surfaces.

The wide use of R-C Meters by public utilities, producers, industrial users and processors is the best evidence of satisfactory performance. For details, ask for Bulletin 40-B-14 or write us about your specific problem.

ROOTS-CONNERSVILLE BLOWER CORPORATION
804 Illinois Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

* * ONE OF THE DRESSER INDUSTRIES * *

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

a chemical resistant, thermal insulating binder is required. These varnishes possess good electrical properties and high mechanical strength and are recommended for laminating sheets, tubes, and gears.

Another phenolic resin product is used to bind sand cores used in the casting of metals. The material is uniform, flexible and non-sticky and has good flowability and low moisture content. This core binder is claimed to impart dry strength to the core materials, to allow the core to be handled while still warm. It is said to impart sufficient strength to the core to withstand pouring temperatures of 2,750 deg. F., evolves a minimum of gas during pouring, and will not impair the properties of the core material after use.

For use in leather finishing are two new resin emulsions which, upon evaporation yield clear, colorless films, low in water absorption. Film flexibility is used without the use of plasticizers, so there is no tendency for the emulsion film to harden as the result of evaporation or migration of the plasticizer into the leather.

58. Surface Active Agents

THREE new groups of surface active agents have been added to the line of chemicals made by Armour & Co., 1355 West 31st St., Chicago, Ill. Having the brand names of Ethomeens, Ethomids, and Ethofats, these materials are derivatives of fatty-acid amines, and may be used as wetting agents, detergents, emulsifiers, and chemical intermediates. Ethomeens are cationic in character, while the Ethomids and Ethofats are non-ionic.

59. Roller Bearing Lubricant

DEVELOPED by the Texas Co., 135 East 42nd St., New York, N. Y., is a new type of roller bearing lubricant for use on locomotive, passenger and freight-car journals. This new grease is designed to replace a liquid oil which has been used in the past. The new grease is water-resistant and will not wash out. It is said to eliminate lubricant leakage to form a seal against dirt, water and dust. By use of various chemical additives it will withstand extreme heat and cold to retain its lubricating powers in all kinds of

The DE LAVAL "Nozzle-Matic"

CONTINUOUSLY SEPARATES TWO LIQUIDS AND A SOLID AND DISCHARGES ALL THREE . . .

● Put centrifugal force to work to speed up separation . . . clarification . . . concentration. The De Laval "Nozzle-Matic" makes it possible to run many processes continuously that were once slowed down by gravity or by less effective means of separating two liquids. Moreover, the "Nozzle-Matic" removes the solids present in the liquids, discharging them continuously.

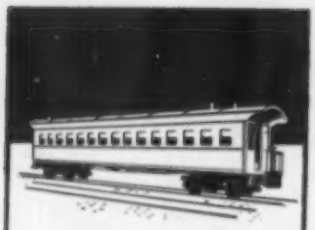
The capacity of the "Nozzle-Matic" is high. It varies, of course, according to the nature of the materials handled. Some fluids or mixtures can be processed at a rate as high as 6,000 gallons per hour. Others must be separated or clarified at much lower rates . . . depending on results desired and the original mix.

The De Laval line of Industrial Centrifugals is large and complete. There is a machine for practically every problem where centrifugal force may be applied to advantage.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, LIMITED, Peterborough

DE LAVAL Centrifugal Machines

. . . FOR PROCESSING SYSTEMS



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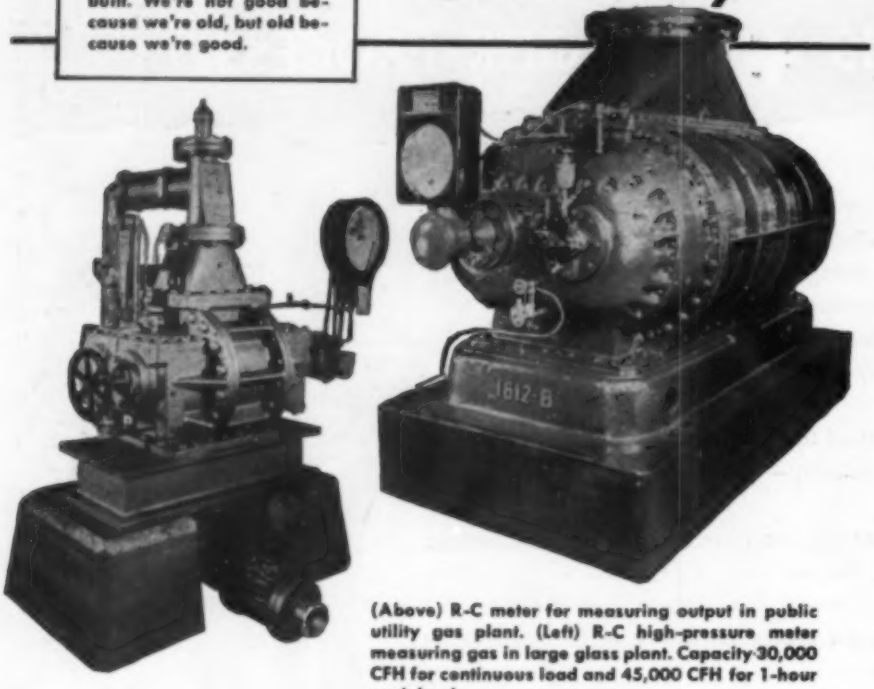

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1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture or impurities.
2. Accuracy does not depend on uncontrollable factors.
3. Accuracy is not subject to adjustment of meter or recorder by operators.
4. Accuracy is not affected by reasonable overloads.
5. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast-iron surfaces.

The wide use of R-C Meters by public utilities, producers, industrial users and processors is the best evidence of satisfactory performance. For details, ask for Bulletin 40-B-14 or write us about your specific problem.

ROOTS-CONNERSVILLE BLOWER CORPORATION
804 Illinois Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE BLOWER BUILDERS R-C SINCE 1854
ROTARY CENTRIFUGAL
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS
• • ONE OF THE DRESSER INDUSTRIES • •

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

a chemical resistant, thermal insulating binder is required. These varnishes possess good electrical properties and high mechanical strength and are recommended for laminating sheets, tubes, and gears.

Another phenolic resin product is used to bind sand cores used in the casting of metals. The material is uniform, flexible and non-sticky and has good flowability and low moisture content. This core binder is claimed to impart dry strength to the core materials, to allow the core to be handled while still warm. It is said to impart sufficient strength to the core to withstand pouring temperatures of 2,750 deg. F., evolves a minimum of gas during pouring, and will not impair the properties of the core material after use.

For use in leather finishing are two new resin emulsions which, upon evaporation yield clear, colorless films, low in water absorption. Film flexibility is used without the use of plasticizers, so there is no tendency for the emulsion film to harden as the result of evaporation or migration of the plasticizer into the leather.

58. Surface Active Agents

THREE new groups of surface active agents have been added to the line of chemicals made by Armour & Co., 1355 West 31st St., Chicago, Ill. Having the brand names of Ethomeens, Ethomids, and Ethofats, these materials are derivatives of fatty-acid amines, and may be used as wetting agents, detergents, emulsifiers, and chemical intermediates. Ethomeens are cationic in character, while the Ethomids and Ethofats are non-ionic.

59. Roller Bearing Lubricant

DEVELOPED by the Texas Co., 135 East 42nd St., New York, N. Y., is a new type of roller bearing lubricant for use on locomotive, passenger and freight-car journals. This new grease is designed to replace a liquid oil which has been used in the past. The new grease is water-resistant and will not wash out. It is said to eliminate lubricant leakage to form a seal against dirt, water and dust. By use of various chemical additives it will withstand extreme heat and cold to retain its lubricating powers in all kinds of

The DE LAVAL "Nozzle-Matic"

CONTINUOUSLY SEPARATES

TWO LIQUIDS AND A SOLID AND DISCHARGES ALL THREE . . .

● Put centrifugal force to work to speed up separation . . . clarification . . . concentration. The De Laval "Nozzle-Matic" makes it possible to run many processes continuously that were once slowed down by gravity or by less effective means of separating two liquids. Moreover, the "Nozzle-Matic" removes the solids present in the liquids, discharging them continuously.

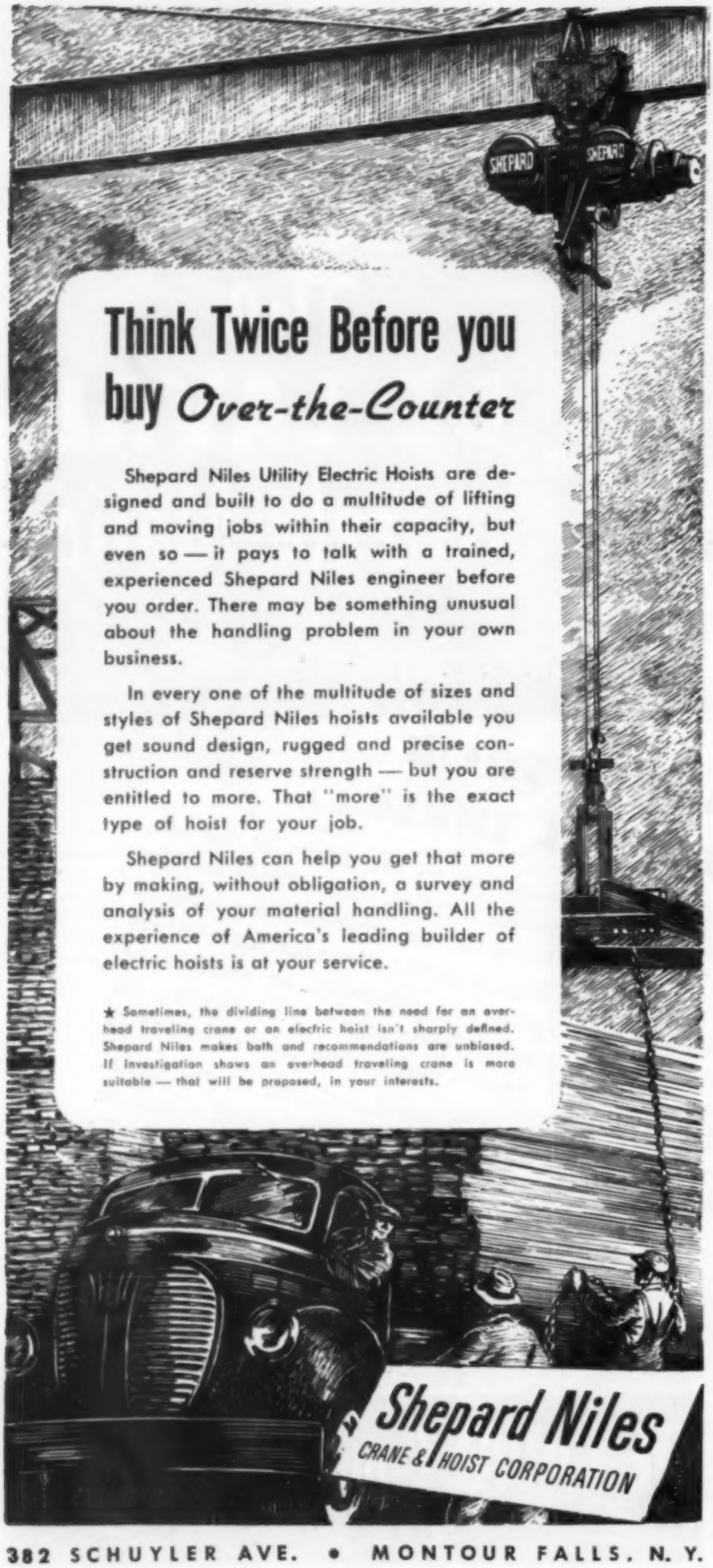
The capacity of the "Nozzle-Matic" is high. It varies, of course, according to the nature of the materials handled. Some fluids or mixtures can be processed at a rate as high as 6,000 gallons per hour. Others must be separated or clarified at much lower rates . . . depending on results desired and the original mix.

The De Laval line of Industrial Centrifugals is large and complete. There is a machine for practically every problem where centrifugal force may be applied to advantage.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, LIMITED, Peterborough

DE LAVAL Centrifugal Machines

. . . FOR PROCESSING SYSTEMS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Think Twice Before you buy Over-the-Counter
Shepard Niles Utility Electric Hoists are designed and built to do a multitude of lifting and moving jobs within their capacity, but even so — it pays to talk with a trained, experienced Shepard Niles engineer before you order. There may be something unusual about the handling problem in your own business.
In every one of the multitude of sizes and styles of Shepard Niles hoists available you get sound design, rugged and precise construction and reserve strength — but you are entitled to more. That "more" is the exact type of hoist for your job.
Shepard Niles can help you get that more by making, without obligation, a survey and analysis of your material handling. All the experience of America's leading builder of electric hoists is at your service.
★ Sometimes, the dividing line between the need for an overhead traveling crane or an electric hoist isn't sharply defined. Shepard Niles makes both and recommendations are unbiased. If investigation shows an overhead traveling crane is more suitable — that will be proposed, in your interests.
Shepard Niles
CRANE & HOIST CORPORATION
382 SCHUYLER AVE. • MONTOUR FALLS, N. Y.

FOR MORE INFORMATION
See Reader Service
Coupon on pages 159-160

weather. It is believed that the new lubricant can remain in service for two years or more without repacking.

60. Bonded Glass Fabric

MADE from continuous glass filaments, an unwoven glass fabric is now available from the Glass Fiber Corp., 36-40 Vernon Blvd., Long Island City, N. Y. For use in plastic impregnation and lamination, this fabric is claimed to be a good reinforcing medium in high and low-pressure molding. Fiber arrangement provides high tensile strength in one direction and good flexibility in the other. Having low binder content, the fabric is uniform in texture and is made in continuous 30-yd. lengths, is 36 in. wide and with a standard thickness of 15 mills. It can be readily spliced with pressure-sensitive tape. For applications requiring a stronger bond, starched bonded glass fabric is also available.

61. Wetting Agent

AN ADDITION to its line of surface active agents has been announced by the Emulsol Corp., 59 E. Madison St., Chicago 3, Ill. Known as Emcol 5100, this wetting agent is of the alkanolamine condensation type, light in color, clear, and has viscosity modifying effects, good wetting and detergency, as well as rinsing properties. It is said to be compatible with both anion and cation, active detergents, and may be used in mildly acid or alkaline ranges.

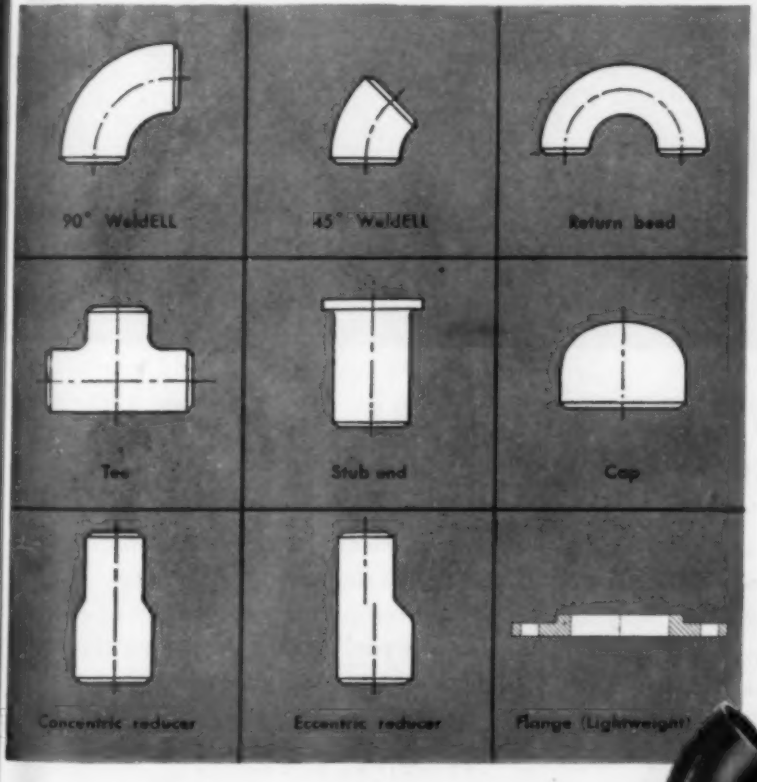
62. Textile Size

PARTICULARLY suited for slasher sizing raw nylon continuous filament warp is the polymethacrylic acid textile size now available from the E. I. du Pont de Nemours & Co., Wilmington 98, Del. Known as PMA, this new size is water soluble, easy to apply, and is easy to remove in scouring. PMA has good adhesion to raw nylon. Flaking or powdering of the size is practically eliminated when PMA is applied to the warp uniformly and in the right amount. For scouring, conventional hot water, soap and alkaline scours have been found satisfactory in removing this size from woven fabric. The material is now manufactured on a limited commercial basis. It is available in 50-, and 100-lb. containers.

Name the problem—

- *High temperature*
- *Low temperature*
- *Product purity*
- *Corrosion resistance*

Here's the answer!



Taylor Forge Welding Fittings and Flanges are available in:

Stainless 304, 316, 347, Monel, Inconel, Nickel, Copper . . . also other usual industrial metals.

Fitting sizes: ¾" through 12" and larger. Wall thicknesses: schedules 40-S, 80-S, 10-S and others. Flange sizes: ¾" through 30" and larger. Coupon brings dimensional data.

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& PIPE WORKS

General Offices: Chicago 90, Ill. (P.O. Box 485)
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Ryerson's function is not only to supply your steel, but to deliver it on time. From the moment the Ryerson switch-board flashes your incoming call until the steel is laid down in your plant, a corps of helpful, intelligent employees well-trained in the Ryerson "Immediate Steel" tradition are at your service.

The likeable young women at the switch-board, phone-order salesmen, dispatchers, crane operators, skilled warehousemen who cut, shear and shape stock sizes to fit your specification, truck drivers—all of them are key people at Ryerson—key people in your service, when you need steel!

In spite of shortages, we are putting forth every effort to serve all Industry to the best of our ability. Naturally, many sizes and certain products are out of stock. However, for the most part you can depend on Ryerson for immediate shipment of a wide range of steel products.

PRINCIPAL PRODUCTS

Bars—hot and Cold rolled	Mechanical Tubing	Tool Steel
alloy steel	Boiler Tubes and Fittings	Wire, Chain
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Structurals	sheets, plates, shapes,	Babbitt
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RYERSON STEEL

CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

Fire Knocks Out Cactus Ammonia Production

FIRE which wrecked the compressor building of the Cactus Ordnance Works on March 6 knocked out anhydrous ammonia production for several months at the largest government-owned plant near Dumas, in the Texas Panhandle. Revised estimates of damage are $1 million. No lives were lost and no one was hospitalized.

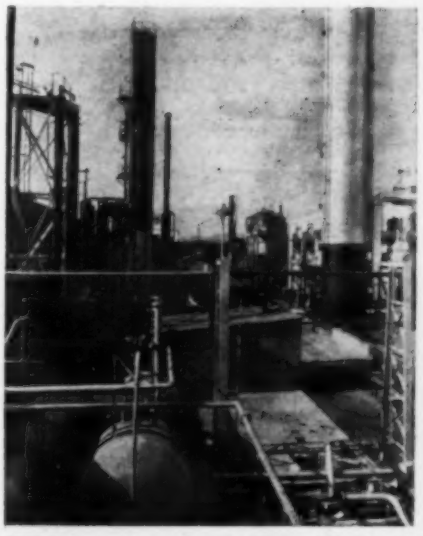
The plant had been producing ammonia for government account and was being operated by Emergency Export Corp. At the time of the fire, bids from several companies for a new lease on the installation were being analyzed.

The compressor building, a sheet iron and wood frame structure, housed 20 gas engine driven compressors. A large mass of piping containing flammable gases was in the basement. An early investigation of the accident indicated that a hydrogen line broke, allowing gas to permeate the building. Six workmen standing near the point where the fire broke out were able to rush from the building before it was engulfed in the rapidly spreading flames. Wooden flooring in the structure contributed to the intensity of the fire.

Damage to piping appeared to be extensive, although an official at the plant thought the heavier parts of the compressors may have escaped serious damage. The flames were brought under control in about a half hour by the combined efforts of plant firefighters and firemen from Dumas, 15 miles south of Etter. Other buildings in the large government plant were undamaged.

Compressor exhausts still stand above the wreckage of heavily damaged compressor building at Cactus Ordnance works, Etter, Tex.

Pittsburgh Coke Forms New Chemical Subsidiary



HCN is converted to sodium thiocyanate at this Neville Island unit

A NEW affiliate for the sale of basic agricultural chemicals has been formed by Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. The new organization will be known as Pittsburgh Agricultural Chemical Co. and will have executive offices in New York.

W. J. Haude is president of the new company. Dr. Joseph B. Skaptason will be vice president in charge of sales and development.

Sales offices in a number of the principal cities of the U. S. and Canada are planned by the new company. While its basic agricultural chemicals will be manufactured in the company's own plant at Neville Island, Pittsburgh, the new affiliate also will handle other products to round out a complete line of insecticides, fungicides, rodenticides, disinfectants, plant hormones and other chemicals.

In addition to present production facilities, Pittsburgh Coke & Chemical Co. currently is undertaking an expansion program of over $2,000,000 to continue its chemical development.

Miamisburg Atomic Energy Unit Called Mound Laboratory

THE Atomic Energy Commission and Monsanto Chemical Co. have named the installation to be operated at Miamisburg, Ohio, by the company. It is now officially called the Mound Laboratory.

Dr. C. A. Hochwalt, vice president of Monsanto and director of the Laboratory, said the laboratory was named for the famous Miamisburg Indian Mound. Originally the facility was to be called Unit No. 5 of Monsanto's Central Research Department.

Stanolind to Erect Fuel Plant in Garden City

STANDARD OIL & GAS Co. has selected Garden City, in southwestern Kansas, as the locality for the large

synthesis plant which the company will begin building this year for the manufacture of synthetic gasoline and chemicals from natural gas. Garden City was chosen because of its proximity to the Hugoton gas field and because community officials have arranged with the company to provide rental housing for the operating staff.

Tests to determine water supplies and the nature of the soil have begun as the first step in determining the exact site near Garden City where the plant will be established. Heavy construction work will begin toward the end of the year. Stanolind officials estimate the plant will be completed early in 1950.

The undertaking will include a natural gasoline plant to remove heavier hydrocarbons from the natural gas before the methane is processed, the synthesis unit, the oxygen production unit, facilities for refining the chemicals, laboratory and power plant.

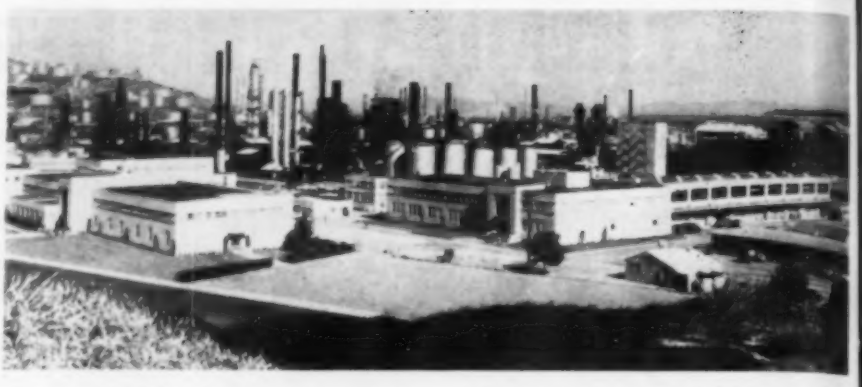
Du Pont Building Texas Ben Hex Unit

CONSTRUCTION of a unit to manufacture benzene hexachloride, a new insecticide, is under way at the La Porte, Tex., plant operated by the Grasselli Chemicals Dept. of du Pont. Estimated to cost at least $1 million, the unit may be in operation early in 1949. Design of the unit was based on pilot plant work conducted at La Porte. The chemical was produced on a limited scale and found to be effective on cotton, peaches and some vegetables and for the destruction of grasshoppers. "Lexone" is the brand name. Du Pont's own engineering staff is building the unit.

Cal. Research Completes Expansion Program

JUST revealed by California Research Corp., San Francisco, is the completion of a postwar expansion program at Richmond, Calif., costing $2,000,000. The new units amount to some 40 percent of total facilities, all of which are used for development of new and better petroleum products and chemicals. A budget in excess of $6,000,000 is planned this year for work at Richmond, the process development unit at El Segundo, Calif., and the oil field research laboratory at La Habra, Calif. This makes Cal Research one of the two largest industrial research firms in the West.

In essence the new additions will allow "more of the same done better." So states Harold G. Vesper, president.



Modern facilities have been completed at Richmond, where California Research Corp. has erected this $2,000,000 research center

Major part of the program involved the erection of a large two-story process laboratory and an extension to the main administration and research laboratory building. Both are located on land reclaimed from the San Francisco Bay and adjacent to the refinery of Standard Oil Co. of California, parent company.

Completed last October, the administration building houses a large portion of the firm's laboratories and service facilities, in addition to offices, library, stock room, photographic laboratory and engineering and drafting rooms. Recently completed, the new process laboratory building is equipped with a number of offices and standard laboratories. Extending 240 ft. to the rear are two large rooms for large-scale equipment and pilot plants. In a seven-story adjacent structure is an atmospheric and vacuum crude-oil plant with a daily capacity of 50 bbl.

Organized in 1919 with a relatively small number of workers, Cal Research was at first a part of Standard Oil. It was incorporated in 1944. Some 850 persons are now employed, of which approximately 675 are located at Richmond.

Manganese Products Producing Fertilizer In Seattle

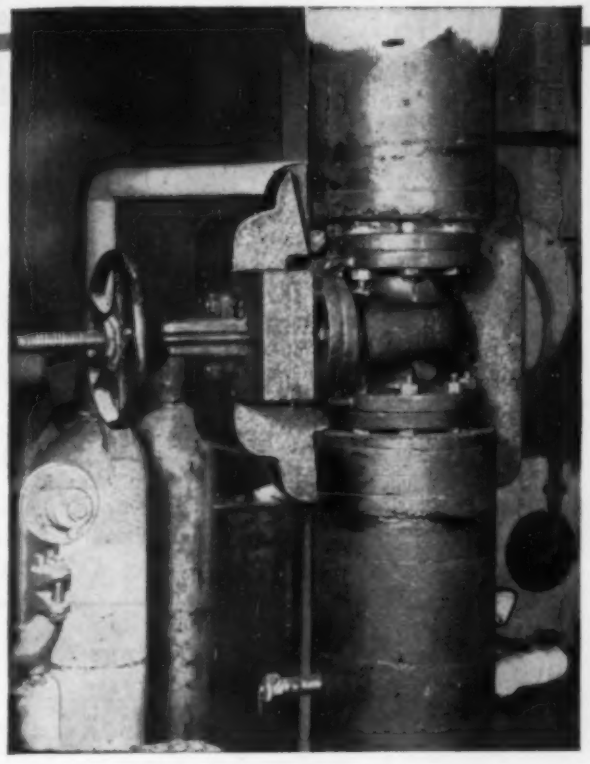
MANGANESE PRODUCTS, INC., of Seattle, Wash., has begun production of calcium magnesium phosphate fertilizer. It is the second firm in this country to produce this type of fertilizer material and the only one outside California. Initial capacity is 50 tons per day. The firm plans to more than double this capacity within a year.

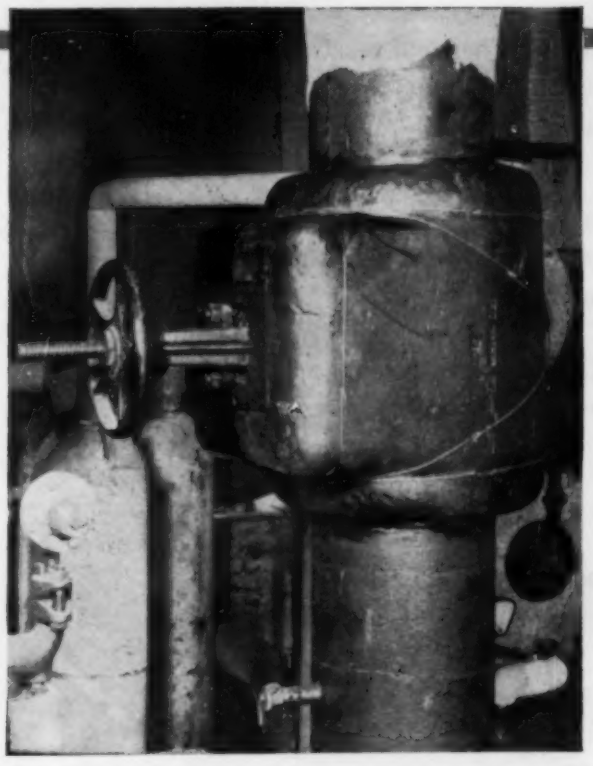
Phosphate rock is obtained from mines at Phillipsburg, Mont., while olivine comes from Cypress Island off Anacortes, Wash. In the process, two parts of phosphate rock to one part of olivine are fed to a Greene electric steel blast furnace whose height has been increased to 10 ft. for this operation. It has a diameter of 8 ft. inside the shell and 5 ft. 7 in. inside the lining, which includes 4.5 in. of fire brick and 9 in. of carbon. Electrodes which are 6 in. graphite, are consumed at the rate of 15 lb. per ton of rock. The furnace has a capacity of 10 tons, but works best when only half filled. The rock takes about two hours to go through the furnace at 1,500-1,600 deg. C. It is tapped at 30-min. intervals.

Molten rock flowing from the furnace is pelted by cold water at 70-100 lb. from nozzles pointed in two directions. This chilling forms calcium magnesium phosphate in the form of black, glassy granules before reversion can take place. The granules fall into a quenching tank 30 ft. long and rising some 9 ft. at one end. Angle irons on a conveyor chain scrape the granules to a conveyor belt where they are sprayed with water to remove residual phosphate for recovery. From an oil-fired rotary

Fertilizer is produced by fusing olivine and phosphate rock in this furnace

How to cut the cost of a good cold line covering job





SINCE a large part of the cost of insulating lines today is the time required for installation, labor-saving materials can make an important cash difference. For example, molded cork pipe covering itself is higher in price than wrap-around materials. But cork covering saves so much time that the total cost for installing it is far less.

This difference is particularly marked in the insulation of valves and fittings. Armstrong's factory built cork covers can be completely installed in less than half the time a good wrapping job will take.

Shown here are two steps in applying one of these covers around a flanged valve. After the second section is wired in place, all voids are filled with Armstrong's Fitting Filler, which is easily and quickly poured into place. Armstrong's Fitting Covers are made to fit exactly all standard tees, ells, and valves—both screwed and flanged. They are manufactured in three thicknesses to handle all temperatures from 35° F. to minus 25° F.

For further information on Armstrong's Cork Covering and Fitting Covers, write today to Armstrong Cork Co., Building Materials Division, 3304 Concord Street, Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

Stock preparation

. . . an important step in manufacturing safety film

Roll upon roll of sheet pulp whipped into a fluffy mass, with all fibers individually exposed for chemical reaction . . . that's a daily assignment for Sprout-Waldron single disc mills.

The same basic function—short fiber separation, is equally important in the production of nitrates, ethers, esters, and CMC. Such marvels of present-day chemistry require correct and carefully controlled stock preparation.

Sprout-Waldron single disc mills offer—

- **Varied and flexible feeding arrangements.**
- **All functional surfaces readily accessible for cleaning.**
- **Special plate designs for extended range of applications.**

Sprout-Waldron Adaptioneering Service — ingenuity + machines + experience — is at your command.

Write Sprout-Waldron & Company, Muncy, Penna.

SPROUT WALDRON
Manufacturing Engineers

dryer, the product is reduced to −100 mesh in a ball mill.

By the end of next year, Manganese Products, Inc., plans to have capacity to produce 150,000-200,000 tons yearly of this new-type phosphate fertilizer and thus to supply much of the phosphate needs of the Pacific Northwest. John R. Allen is president and general manager, while Dr. R. W. Moulton, associate professor of chemical engineering at the University of Washington, is technical director. Other technical personnel include R. C. Grant, plant and production manager; Norman Kitzlach, chief chemist; C. W. Richardson, plant superintendent.

Lignite Research Laboratory To Be Built In North Dakota

A $750,000 lignite coal research laboratory for North Dakota has been authorized by Congress, together with authorization of annual appropriations of $250,000 a year to operate the proposed lab. The research to be undertaken by Congressional direction: the mining, preparation, and utilization of lignite coal, and the development of new scientific, chemi-

CONVENTION CALENDAR

American Oil Chemists' Society, spring meeting, New Orleans, May 2-6.

American Institute of Chemists, annual meeting, Hotel Pennsylvania, New York, May 7.

American Institute of Chemical Engineers, regional meeting, Hollenden Hotel, Cleveland, May 9-12.

Second Engineering Progress Show, Franklin Institute, Philadelphia, May 11-16.

Society of Plastics Industry, annual meeting, Ambassador Hotel, Atlantic City, May 20-21.

Society for Applied Spectroscopy, Symposium on Spectroscopic Equipment, Polytechnic Institute of Brooklyn, Brooklyn, May 22.

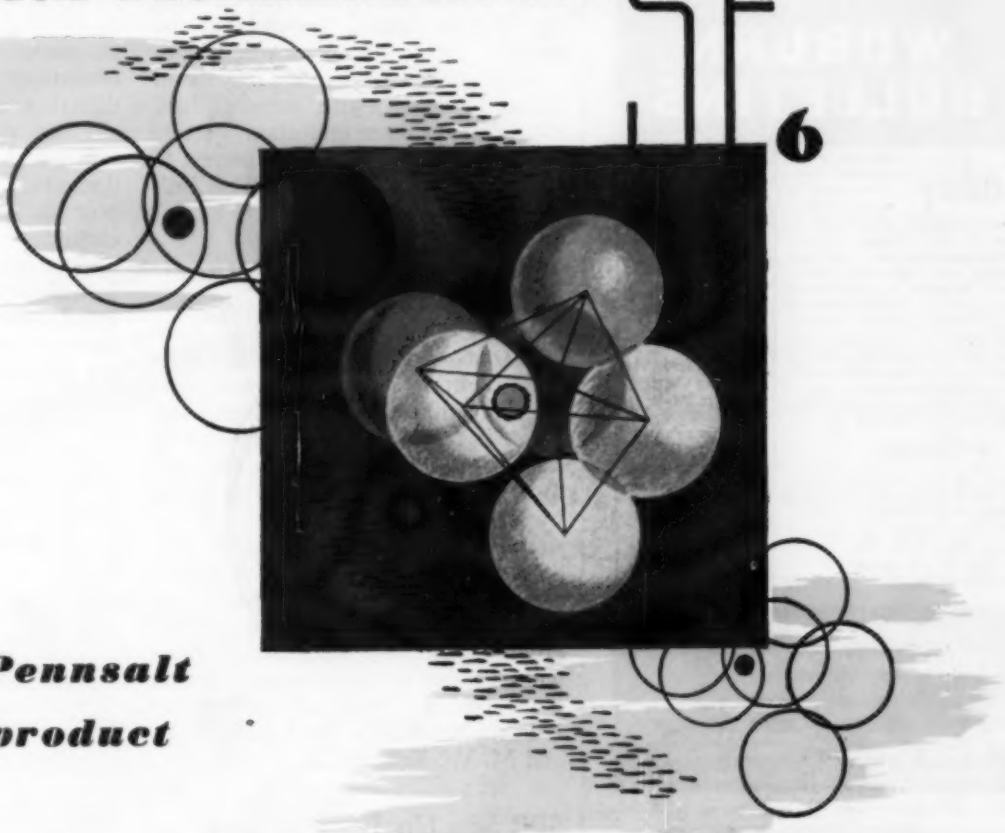
American Society for Testing Materials, 51st annual meeting, Book-Cadillac Hotel, Detroit, June 21-25.

Western Packaging Exposition, San Francisco Civic Auditorium, San Francisco, August 10-13.

Third Instrument Conference and Exhibit, Convention Hall, Philadelphia, September 13-17.

National Plastics Exposition, Grand Central Palace, New York, September 27-October 1.

Sulphur Hexafluoride... SF_6



another Pennsalt fluorine product

Sulphur Hexafluoride (SF_6), produced from elemental fluorine, is a new addition to Pennsalt's growing list of Fluorine Chemicals.

Sulphur Hexafluoride is a very inert gas, resembling nitrogen in its degree of inactivity. It is odorless, colorless and sparingly soluble in water. The gas is 5 times as heavy as air and is reported to be stable to at least 800°C (1472°F). It is non-flammable and published data indicate that it is non-toxic.

As indicated by the data given here, Sulphur Hexafluoride is suited for use as a gaseous dielectric medium for high voltage equipment, as a refrigerant and as a fire extinguisher . . .

PROPERTIES OF SF_6

Molecular weight: 146.1
Melting Point (at 30 lb./sq. in. absolute): −59.4°F (−50.8°C)
Sublimation Temperature: −82.8°F (−63.8°C)
Density of liquid at −59°F(−50°C): 119 lb./cu. ft.(1.91 g./cu. cm.)
Specific gravity of gas at 1 atm. 68°F (20°C) (air=1): 5.106
Critical Temperature: 113°F (45°C)
Critical Pressure: 510 lb./sq. in. (35.4 atm.)
Critical Density: 48.6 lb./cu. ft. (0.779 g./cu. cm.)
Free Energy of Formation: −237 kg. cal. / mol.

Sulphur Hexafluoride is available in experimental and commercial quantities. For more information on this and other new Pennsalt fluorine products, write: The Pennsylvania Salt Manufacturing Company, Whitemarsh Research Laboratories, Special Products Division, Box 4388, Chestnut Hill P.O., Philadelphia,Pa.

Pennsalt, foremost producer of fluorine chemicals, offers:

ELEMENTAL FLUORINE—available in cylinders containing ½, 4 and 6 pounds.

There are many new Pennsalt fluorine products in experimental stages. Some of which include:

SILVER DIFLUORIDE (AgF_2)—a fluorinating agent; coarse, free-flowing, greyish brown powder. Molecular weight 145.9; 13% available fluorine.

COBALT TRIFLUORIDE (CoF_3)—a fluorinating agent; fine, free-flowing, light brown powder. Molecular weight 115.9; 16.5% available fluorine.

METALLIC FLUORIDES—including lead, zinc, cadmium and sodium chromium fluoride.

NEW ORGANIC AND INORGANIC fluorine compounds requiring technically pure fluorine as raw material.

PENN SALT

fluorine chemicals

A "must" for modern processing — THE WOBURN BULLETINS

Today almost every product manufactured is dependent upon organic chemicals at one or more stages of development between raw materials and consumer products. Woburn is recognized for scientific development of specification organic chemicals meeting individual industrial requirements. Woburn technical Bulletins are available describing many applications and technical characteristics.

• Write

—tell us the specific Bulletins desired — also special information concerning organic chemicals developed to your specifications.

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Fatty Acids for Soaps
Woburn Conjugated Fatty Acids
Wolin Oil
Fatty Acids in the Textile Industry
Alkyd Resin
Formulas • Isoline Isoline Varnish
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The role of Oxidation in Drying Oils
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PLAN TO ATTEND

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1948

cal, and technical uses for lignite coal and its products.

The law authorized the Secretary of Interior, acting through the Bureau of Mines, to establish an advisory committee of six, representing lignite mine owners, workers, and the public.

Next step: studies by Bureau of Mines to locate a site, prepare plans, etc. Perhaps more important: getting an appropriation through Congress to actually construct the lab. This isn't likely this session.

Magnolia Petroleum Expands Lubricant and Wax Output

MAGNOLIA PETROLEUM COMPANY'S expansion program at Beaumont, Tex., for the manufacture of lubricants and waxes is expected to be completed by January 1949. The undertaking will increase capacity for these products by about 50 percent. The construction program covers five major projects: a pipe still, two vacuum towers, a unit for refining with furfural and a refining unit employing methyl ethyl ketone. A boiler and turbine will be added to the company's Power Plant No. 2. Principal construction is being handled by the Lummus Co. and M. W. Kellogg Co.

SPE Sets Up Local Section In New Orleans

ENGINEERS and chemists interested in the plastics field have organized the New Orleans Section of the Society of Plastic Engineers with headquarters at New Orleans. Officials are: president, H. A. Levey, American Products Manufacturing Co.; vice president, Ralph F. Chambers, Plastic Productions, Inc.; secretary-treasurer, Paul F. Oswald, Oswald Engineering Co. Prior to the organization the New Orleans group interested in establishing the Section was addressed by Thomas E. Orr, national president of S P E.

Overseas Consultants Report on Japanese Reparations

THE Department of the Army has released the report submitted to it by the Overseas Consultants, Inc., on the subject of Japanese reparations. The participating members were: Standard Research Consultants, Inc.; Jackson and Morland; American Appraisal Co.; F. H. McGraw and Co.; Coverdale and Colpitts; Ford, Bacon and Davis; Sanderson and Porter; Stone and Webster Engineering Corp.; J. G. White Engineering Corp.; Ebasco Services, Inc., Madigan and Hyland. Clifford S. Strike, president of F. H. McGraw, is president of the Overseas Consultants.

This group concluded that the problem of restoring the economy of Japan to a self supporting basis, even at the low standards of 1930-34, is an enormous task. Under the best conditions it will call for intelligent direction and hard work and above all, for opportunity to produce a sufficient amount of civilian goods for domestic consumption and for export in order to provide food and clothing for the rapidly increasing population. Removal of productive facilities, except the war facilities listed below would hurt world production and would be expensive to the American taxpayer. It would not be in the best interests of the claimant nations.

The following facilities should be made available as reparations, according to the report.

Recommended for Disposal

	Metric Ton Capacity	Value (1939 yen)
Nitric acid	107,000	9,648,000
Synthetic rubber	900	10,236,000
Shipbuilding (gross tons)	385,000	118,138,000
Aluminum and magnesium fabricating	50,000	21,688,000
Magnesium reduction	480	12,559,000
Primary war facilities		1,475,887,000
Total		1,648,156,000

In view of their findings, the group recommended against any removal of other productive facilities which can be used effectively in Japan.

Defunct Chemical Unit Purchased by Obitts

PROPERTIES of the defunct Norwalk Chemical Co., Norwalk, Ohio, have been acquired by the newly organized Obitts Chemical Co., Inc. Officers in the new company are R. W. Obitts, president, L. A. Obitts, secretary-treasurer, and E. R. Day, works manager.

Included in the purchase is a two story manufacturing building, a boiler house and partly completed annex building which the new owners plan to use as a laboratory. The new corporation's works will process various industrial solvents.

Congress Cuts Funds for Federal Agencies

GOVERNMENT research and chemical activities suffered in varying degrees at the hands of the House Appropriations Committee last month. Few agencies went through this first roll of the Congressional wringer without leaving behind dollars which had been requested for their operation in the President's budget for fiscal 1949.

Another

edge moor achievement in process equipment fabrication

THIS high pressure autoclave, 900 pounds internal working pressure, 320 pounds jacket working pressure, is another Edge Moor achievement in process equipment fabrication . . . a direct result of Edge Moor experience, facilities and proficiency.

Edge Moor is equipped to furnish *any type* of heavy-wall welded fabrication to your individual designs, specifications or requirements. Materials include:

CARBON STEELS	MONEL	NICKEL
STAINLESS STEELS	HERCULOY	INCONEL
CLAD STEELS	HIGH CHROME	NICHROME
NICKEL STEELS	18-8 ALLOYS	EVERDUR

Edge Moor Shops have complete facilities for stress-relieving, annealing and X-ray . . . and are approved by leading insurance companies for fusion welding to meet all codes and tests We shall be pleased to place our experience and facilities at your disposal when you are considering additional plant equipment. Write for literature *today*.

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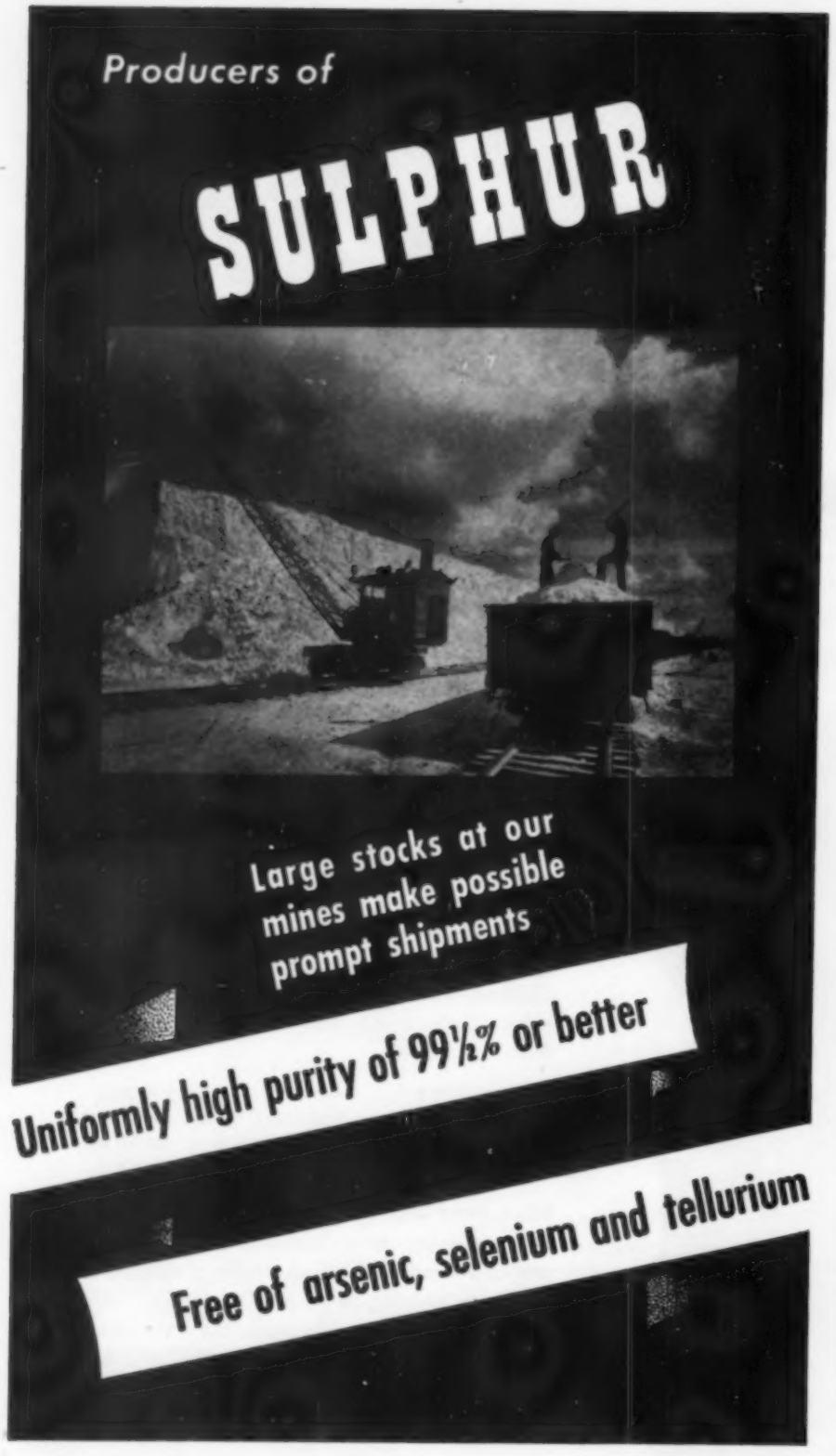

Producers of
SULPHUR
Large stocks at our mines make possible prompt shipments
Uniformly high purity of 99½% or better
Free of arsenic, selenium and tellurium

TEXAS GULF SULPHUR CO. INC.
75 East 45th St. New York 17, N. Y.
Mines: Newgulf and Moss Bluff, Texas

Those that took the worst trimming are hoping that the Senate will restore the House cuts, at least in part as frequently happens.

Here are some of the cuts dealt by the House committee to particular agencies and bureaus of interest to chemicals:

National Bureau of Standards—funds for research and testing cut $855,000 below budget request of $4,755,000. The committee-approved figure is $2,100,000 below the amount available for this work in fiscal 1949.

Office of Technical Services—nothing for 1949 compared with $790,000 in 1948, and $520,000 asked for fiscal 1949.

Bureau of Census—no appropriations for a census of business, long sought by business groups. Current statistical reports, supported by $5.7 million in 1948, would get only $3.7 million in 1949, a real reduction.

Anti-Trust Division, Department of Justice—increase to $3.4 million is recommended, compared with an appropriation of $2.4 million in 1948, and a budget request for $3.2 million.

Tariff Commission—$1.2 million approved for 1949, which is the amount requested in the budget. That's a $50,000 increase over 1948.

Agricultural Research Administration—$45,000 requested to develop and study slow-acting, high-analysis synthetic nitrogen fertilizers was killed. Bureau of Agricultural and Industrial Chemistry which was in the 1949 budget request for a total of $5,664,050, the same as 1949, was reduced by $75,000.

Chemicals Reorganization In Commerce Department

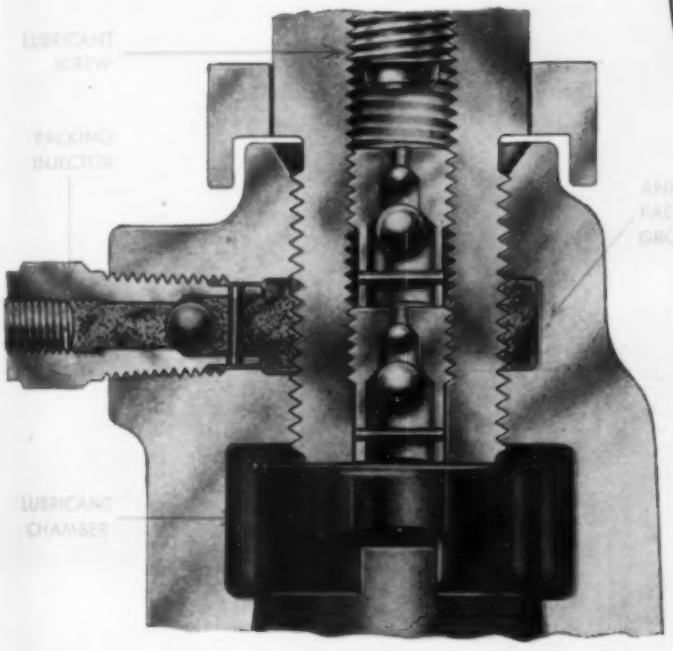
THE chemicals and drugs section of the Department of Commerce has been split into two groups. Foreign chemicals under C. C. Concannon go to the Office of International Trade. Domestic chemicals stay in the Office of Domestic Commerce under Frederic Arden, newly appointed.

International trade in chemicals and foreign chemical operations will be the responsibility of Mr. Concannon's "Chemicals Branch." Going with him to the offices in Temporary "T" Building, 14th and Constitution Avenue, N. W., are a number whose names are familiar to *Chem. Eng.* readers. Tentatively scheduled in this group are Miss Swift and Messrs. Barber, Delahanty, Horner, Markwood, and Rager. This group will also be responsible for issuing export licenses on chemicals and related materials.

The domestic chemical industry and its problems will be handled by

The ONE valve which can be repacked under pressure in ANY position

Instead of relying upon a stuffing box to hold high pressure around the stem, the Nordstrom Hypreseal valve provides a far superior means. The recessed, injection-type packing around the stem can be tightened at any time (or an additional supply injected) without removing pressure from the line or disturbing the position of the valve. The Hypreseal stem threads carry the pressure-thrust, and this force has no effect upon the plug seating thrust.



DETAIL OF UPPER SECTION OF HYPRESEAL VALVE

ESSENTIAL ON CHEMICAL LINES

FOR RESISTING CORROSION AND EROSION

Use of the Nordstrom Hypreseal valve on chemical lines has resulted in most economical operation by reason of the many protective features in design and construction. A film of lubricant distributed between the tapered plug and its seat insures easy turning and protection against corrosion, erosion and intrusion of line fluids. Grooves in the plug, connecting with grooves in the body, form an unbroken circuit around each port, so that pressurized lubricant in the grooves prevents leakage internally and externally. There is no place where line contents can lodge within the valve. Easy turning is insured.

Keep upkeep down

Use genuine Nordcoseal lubricants

Nordstrom

HYPRESEAL VALVE

NORDSTROM VALVE DIVISION — ***Rockwell Manufacturing Company***

Offices: 400 North Lexington Avenue, Pittsburgh 8, Pa., Atlanta, Boston, Chicago, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa

. . . and Leading Supply Houses

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Test Viscosity

WHERE IT COUNTS THE MOST

WHEN IT COUNTS THE MOST

at Point of Process!

WITH A

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SYNCHRO-LECTRIC

VISCOMETER

At last, Point of Process Viscosity readings are not only practical, but simple, rapid, and accurate as well. The Brookfield Viscometer is portable and plugs into any ordinary electrical outlet for connection. Operation is completely automatic and readings are given directly in centipoises.

ONLY A BROOKFIELD HAS ALL THESE ADVANTAGES

- Portable — use in lab and plant
- Rapid — readings in 30 seconds
- Accurate — within 1% of range
- Simple — no technical knowledge to operate or to read
- Rugged — built to take plant handling without getting out of order.

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the "Chemicals and Drugs Section" which is to remain in the Department of Commerce building near its present location. Voluntary industrial agreements in the chemical field, as authorized by Public Law 395, will be part of the duties of this group. Among those of the old unit staying in the domestic section are Messrs. Burke, Cooling, and Hoffheins.

Atomic Research Reports to Be Published in 60 Volumes

COMPILED reports on American atomic energy research are going to be made available to the public. The U. S. Atomic Energy Commission and Columbia University announced plans last month for distribution and sale of the first two volumes of the Manhattan Project Technical Section of the National Nuclear Energy Series. The volumes will be published by the McGraw-Hill Book Co. and will cover declassifiable research and development results obtained by all major installations of the Manhattan District, Army Engineers, and AEC.

First two volumes will deal with contributions to medical science resulting from work on the Manhattan Project. First to be published deals with the histopathological effects of radiation. The second is on the pharmacology and toxicology of uranium and fluorine compounds.

The complete series will provide a comprehensive summary of the technical development of wartime research. In certain cases research data accumulated up to Jan. 1, 1947, and even later, are included to complete studies only partially finished at the end of the war. Most volumes of the series are written by the experts who made possible the wartime developments in nuclear science, and embody their intimate knowledge of developments on the Manhattan Project.

Surplus Tulsa Sulphuric Plant Sold to Ozark

THE Ozark Chemical Defense Corp. sulphuric acid plant at Tulsa, Okla., has been purchased for $670,000 from War Assets Corp. by Ozark-Mahoning Co., wartime lessee of the plant. An original investment of $1.3 million, the plant has a rated capacity of 320 tons of acid per day.

Commercial Research Groups Meet in New York

LAST month New York played host to meetings of the Chemical Market Research Association, and the Com-

(*Continued on page 183*)

TANKS

TO YOUR SPECIFICATIONS

When it comes to tanks and pressure vessels, you can count on Cole to give you a job of design and construction that will deliver safe, dependable service with a minimum of maintenance. We design, make and erect storage tanks for gases and liquids; refinery towers, creosoting cylinders, pulp digesters, and all forms of steel plate fabrication. Let us know your needs. We'll send details and costs.

Write for the latest Cole catalog — "TANK TALK"

Established 1854

R.D. COLE

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NEWNAN, GA.

Fire Fighter Extraordinary!

It's available again — Maltese Cross, the fire hose made with extra-long cotton fibers

For 50 years the chemical and oil industries have recognized Maltese Cross Fire Hose as outstanding for fire-fighting service in refineries, oil tankers, acid plants and many other places.

And no wonder! They know that the use of special, extra-long-fiber cotton duck gives this famous fire hose *extra strength, light weight, extreme flexibility and extra life.* They know that its high burst-resistance is your assurance of a hose that is always ready for action.

They know, too, that the high quality protecting rubber cover prevents deterioration of the reinforcing duck by acid fumes and moisture.

Hewitt could not manufacture Maltese Cross Fire Hose during the war because the special long-fiber cotton was unobtainable and use of the high quality rubber compounds required for this hose was restricted. Now these limitations have been removed . . . and Maltese Cross Fire Hose is back in production!

So contact your Hewitt distributor listed in the classified pages of your phone book. Or write Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, New York.

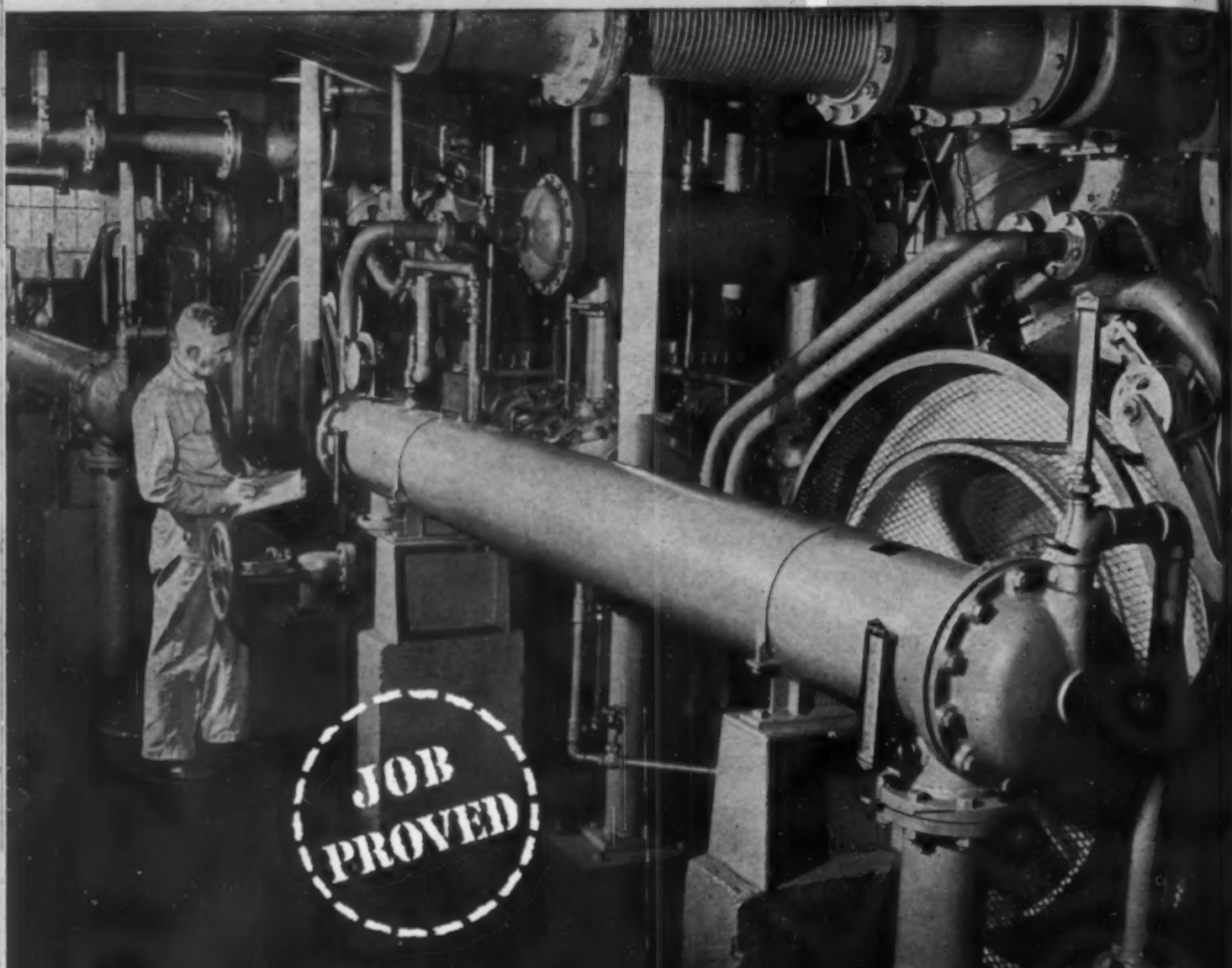
HEWITT
MALTESE CROSS
FIRE HOSE

Why Maltese Cross Fire Hose is recognized as foremost in its field

1. Long-staple, high-tensile duck makes this hose light in weight, flexible, highly burst-resistant.
2. Special chemical treatment protects duck against deterioration from mildew. This feature, combined with rubber cover, eliminates need for drying after use.
3. Highest quality rubber compounded tube, plus extra-tough cover, enables hose to withstand coiling for long periods of time without cracking.
4. Cover protects duck carcass from moisture and acid fumes. Also resists weathering and sun-checking.

HEWITT RUBBER DIVISION, HEWITT-ROBINS INCORPORATED — MAKERS OF INDUSTRIAL HOSE • BELTING • PACKING

Compressing Maintenance Problems



SUN COMPRESSOR LUBRICANT...

Keeps Compressors Operating Four Years on 24-Hour-a-Day Schedule

Twenty thousand and ten hours of trouble-free operation were piled up by one unit in a big, industrial plant operating a battery of heavy-duty 400 horsepower compressors. There was no time out except for routine inspections. Sun Oil was used from the very first hour these compressors were installed. When they were finally shut down for thorough inspection, no wear was apparent and no major parts had to be replaced.

Sun "Job Proved" industrial lubricants are making similar impressive records in all kinds of industrial plants, keeping production on an even, round-the-clock basis, holding down maintenance and operating costs. If you have problems concerning the lubrication of compressors, power plants, machine tools or other industrial equipment—remember the Sun Engineer is at your service without obligation on your part. Just phone the nearest Sun office or write Dept. CE-4 . . .

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INDUSTRIAL PRODUCTS

mercial Chemical Development Association. Both meetings were well attended and despite the related interests of the two groups, there was very little overlap in the papers and discussions. Included below are excerpts of some of the talks presented at the Hotel Roosevelt before the CCDA, of which Lauren B. Hitchcock, vice president of the Quaker Oats Co., is president and John B. Calkin of Union Bag and Paper Corp. was chairman in New York.

"Of all the branches of American manufacturing industry, today the chemical industry is the heaviest consumer of capital, having spent for new plant and equipment during 1947 approximately $1,400 million—$200 million more than the electric utilities and $300 million more than the railroads."—Henry C. Breck, vice president, Union Securities Corp.

"In order to restore working capital to a normal relation to sales and at the same time to complete the plant expansion program and pay out the large amount of dividends, new financing during 1948 may be necessary on a considerable scale and perhaps in a market that may not be very favorable."—Ragnar D. Naess of Naess and Cummings.

"Chemical industry is not depression proof. Looking to the future we must make certain that a rational and logical balance is maintained between an understandable zeal for increased production and the cold realities of economic life."—William P. Marsh, executive vice president, U. S. Industrial Chemicals, Inc.

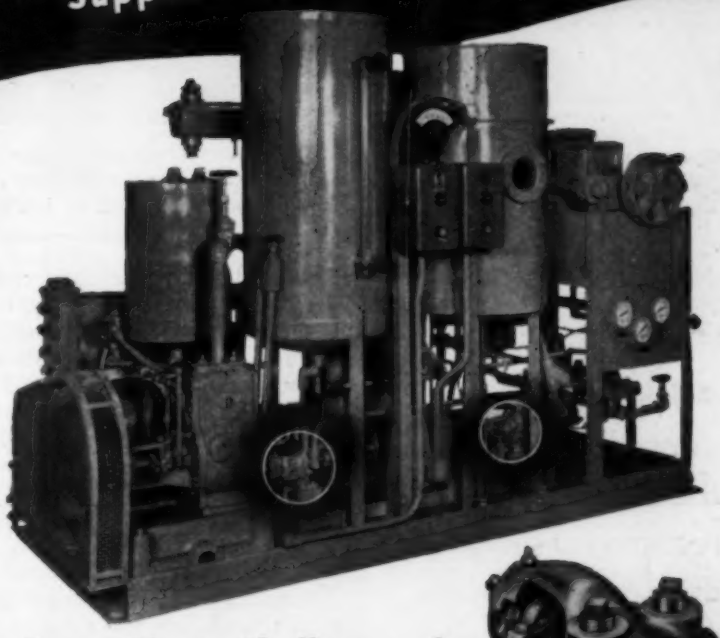
"A proper, timely impartial evaluation—often by an outside agency—may avoid the danger point in a chemical development when premature promotion and sales might make the difference between success and failure."—D. K. Ballman, assistant general sales manager, Dow Chemical Co.

"Research men should be constantly reminded that a new product is not better than an old product because it is harder or better looking or more durable. It is better than the old product only if their company can make more money selling it and only if their company's customers can simultaneously get more satisfaction or make more profit for themselves by buying the new product rather than the old."—Clifford F. Rassweiler, vice president for research and development, Johns-Manville Corp.

"Enthusiasm on the part of the manufacturing division in the successful commercial development of a chemical product may bring lower costs and better and safer distribution. In turn, proper planning and

SUCTION

For Buckeye Oil-Purifying Process Supplied by Roper Pumps



Roper Pump Meets Challenge of 28+" Vacuum

Buckeye Laboratories Corporation of Cleveland, Ohio, makers of equipment for cleaning, dehydrating, degasifying and stabilizing oil, install Roper Pumps as integral parts of their equipment. On the machine illustrated above, a Roper Pump transfers oil under pressure to the atomizing nozzles which in turn spray the oil mist into the vacuum chamber.

As the processing is completed another Roper pumps the purified oil from the vacuum chamber. This requires exceptional pumping efficiency to maintain a flow against the resistance of a 28 + " vacuum.

Another example of Roper adaptability to an almost limitless range of uses.

Roper 4-port design offering 8 different piping connections cuts installation time and costs to a minimum . . . 4 piping arrangements with pump operating clockwise and 4 other arrangements for counter-clockwise operation.

Ropers run quietly and efficiently in either direction. They are designed along the correct hydraulic principle and built compactly to fit a wide range of application and mounting conditions.

Send for Bulletin

Illustrating and describing pumps built to handle pressures up to 1000 lbs. p.s.i., capacities ¾ to 300 g.p.m. at speeds up to 1800 r.p.m.

GEO. D. ROPER CORPORATION

ROPER Rotary Pumps

144 Blackhawk Park Ave.
ROCKFORD, ILLINOIS

• Perhaps Missouri does not produce the rare materials required in the generation of atomic power---BUT,

POSSESSES MANY QUALITIES WHICH ARE DISTINCTLY ADVANTAGEOUS TO THE OPERATIONS OF A GREAT MANY INDUSTRIES.

Write on your business letterhead for a new industrial brochure. Ask for specific information about Missouri as it is related to your particular type of business.

MISSOURI DIVISION of RESOURCES & DEVELOPMENT
Dept. 55-P or 1809 G. St., N. W., Washington, D. C.

I-29

Harshaw Chemical Co. has opened this modern plant library in Cleveland. It is located in a new building that connects laboratories and office. Dr. C. Cassidy, chief of intelligence service division, is in charge

scheduling by the commercial development department may be an incentive to the manufacturing group for better results in marketing new chemicals and expanding old ones."—John J. Healy, Jr., asst. general manager, Merrimac Division, Monsanto Chemical Co.

"A very startling but often unrecognized fact is that the average life of a blue chip company is less than 35 years. Within that time span the majority vanish from profit and prominence—hence the need to invest in research and development by a planning group, made up of top management, with a sole responsibility for planning 35 years ahead."—Westbrook Steele, executive director, Institute of Paper Chemistry.

The CMRA met in the Biltmore Hotel, under the chairmanship of its president, Paul J. Carlisle of E. I. du Pont de Nemours & Co. The papers that were presented created considerable interest. Following are some of the highlights.

"Contract purchases of petroleum and natural gas at distressed prices are gone forever. The heyday of

OLDBURY
ELECTRO-CHEMICAL COMPANY

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AMORPHOUS
PHOSPHORUS

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PHOSPHORUS
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Manufactured to strict specifications
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Plant and Main Office:
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ARE YOU CRACKING UNDER HEAVY MAINTENANCE COSTS?

IN "CRACKING" petroleum . . . in processing and handling chemicals of all kinds . . . maintenance is a continuing expense. You can keep that expense *down* by keeping your equipment *up* with coatings of *Liquid Aluminum.*

On metal structures, for instance, you can so easily sidestep damage by rust and corrosion with good aluminum paint. Aluminum paint will also sharply reduce evaporation losses from storage tanks. It's low cost, long lasting protection—and a beauty treatment, to boot.

To be sure of quality, buy aluminum paint made by a reliable manufacturer; and ask whose aluminum pigment it's made with. If it's Reynolds Pigment, that's the very foundation of quality . . . and has been so for a quarter-century.

Because Reynolds works so closely with the paint industry, the chances are that the good brand of aluminum paint you buy will be made with Reynolds Pigment. But it will pay you to check back and make sure. For when it's made with Reynolds Pigment, it's more than paint—it's *Liquid Aluminum.*

Reynolds Metals Company, Pigment Division, 19 East 47th Street, New York 17, N. Y.

IT'S MORE THAN PAINT . . . IT'S LIQUID ALUMINUM

REYNOLDS METALS

REYNOLDS ALUMINUM PIGMENTS

Reynolds Pioneering Made Aluminum Competitive—*take advantage of it!*

VERSATILE

REFRASIL

FIBROUS SILICA

WILL IT SOLVE A PROBLEM FOR YOU IN ANY OF THESE USES?

AS INSULATION FOR: high temperature power equipment; hot gas ducts; electrical wire and equipment; electric muffle furnaces... As a covering for thermo-couple lead wires... As a catalyst or catalyst support... As incombustible long-life wicking material... As a chemically stable, versatile material, the full extent of usefulness of which is only now being realized. Refrasil, originally developed for aircraft jet insulation, has such exceptional properties as...

- ★ WITHSTANDS 2000°F. INDEFINITELY
- ★ RESISTANT TO MOST ACIDS
- ★ EXTREMELY LOW IN WEIGHT AND BULK
- ★ RESISTANT TO VIBRATION
- ★ LOW THERMAL CONDUCTIVITY

AVAILABLE IN THESE FORMS:

BATT, in rolls approximately 14′x3½′x3/16″ thick; CLOTH in rolls of random lengths approximately 32″ wide x 0.015″ thick; TAPES—SLEEVINGS—CORDAGE, in various sizes and lengths; BULK, in loose fibers; PREFABRICATED BLANKETS, to specification either permanent or removable.

WRITE...

THE H. I. THOMPSON CO.
Section 24-4, 1733 Cordova St.
Los Angeles 7, Calif.

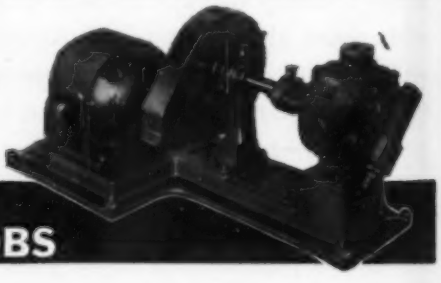
Abrasives research is under way at this new laboratory, recently completed at Chippawa, Ont., by Norton Co. Building is completely air conditioned and equipped with latest type spectrographic and microchemical equipment

natural chemicals from natural gas is ending. More stringent economic conditions are foreseen for petroleum chemical developments."—James H. Boyd, chemical and commercial consultant.

"I have been active in the building industry since 1906—through four recessions or depressions. My observation is that in such periods very few major building projects go ahead, even though building costs may seem on a bargain basis. In other words, industrialists who wait for materially lower costs than those prevailing today probably would not build even at that time. My judgement, therefore, is that if one needs a building and can make money with it, he should build now rather than follow the will-of-the-wisp of materially lower building costs in the next few years."—John P. H. Perry, vice president, Turner Construction Co.

"Hard-headed professional investment managers, who examine offerings for corporate and individual investors, do not wish merely to be 'sold.' They want to be 'told'—to know the adverse circumstances as well as the

Vikings



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There is no general compromise when Vikings go in on the job. Correct design, size, construction, material, speeds, power, etc. are basic factors in furnishing correct equipment for any pumping job.

See that your pump meets these requirements. Insist on Vikings—the pump that is built for the job from start to finish. It's the standard in rotary pumps for over a third of a century.

Write today for folder 47SC. It will be sent free by return mail.

See Our Catalog In SWEETS

Viking PUMP COMPANY
Cedar Falls, Iowa

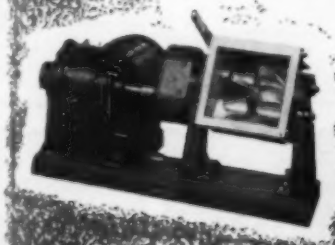
To give you an accurate laboratory prediction of performance on your job, READCO will conduct tests with the material you want mixed—before quoting.

Experienced engineers design your READCO Mixers to suit your individual needs, incorporating the features that will assure maximum mixing efficiency for your particular product.

No guesswork!

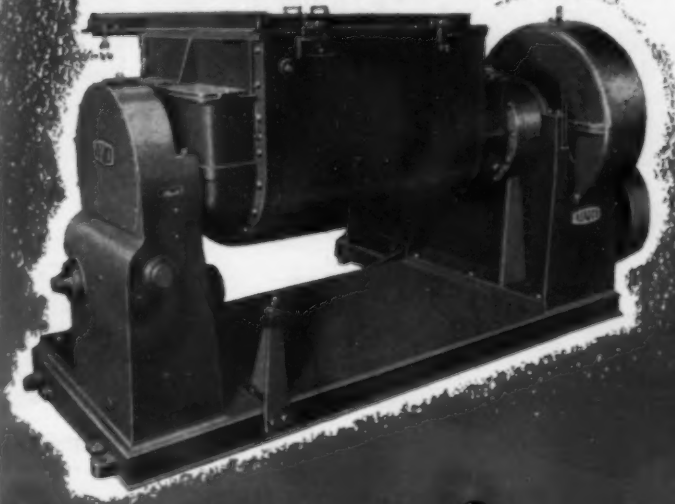
READCO MIXERS are "tailored" to fit your operation

Whatever mixing problems you have, READCO Mixers can solve them . . . because they are "individually tailored" to fit your particular operation. In addition, "plus features" help you reduce overhead and boost profits by increasing your production and improving quality. These READCO models are typical:



DOUBLE ARM VACUUM MIXERS have single packing gland construction which eliminates the possibility of contamination or oxidation. Heavy duty construction of common metal or any commercial alloy. With or without jackets. Non-vacuum mixers also available.

LABORATORY MIXERS are designed for easy dismantling of mixing bowl, without tools, and easy cleaning. One to six quart capacities in a variety of types.



For complete information on "individually tailored" READCO Mixers, write READCO today.

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MACHINERY DIVISION

of THE STANDARD STOKER COMPANY, INC. YORK, PA.

favorable ones. It will pay every company to help in constructive efforts to obtain capital funds for new plants and laboratories, for more and better jobs, for steadier income with fewer risks for the investor."—William K. Beckers, partner of Spencer Trask Co., vice chairman, New York Stock Exchange.

"In the immediate postwar period we found our company—like many others—faced with problems that required increasing amounts of market research. Activities of the war years resulted in expanded and diversified production so that the corporation now finds itself supplying new industries and new users of organic chemicals. As far as chemicals are concerned market research activities have only just begun."—J. E. Magoffin, manager of chemical sales development, Tennessee Eastman Corp.

"The field of market research is as broad as the range of problems confronting business executives. It is not limited to consumer surveys nor library statistical studies. It is a vital part of top management, not a luxury."—David R. Longman, associate director, marketing and research division, Dun and Bradstreet, Inc.

READERS' VIEWS AND COMMENTS

Small vs. Large Business

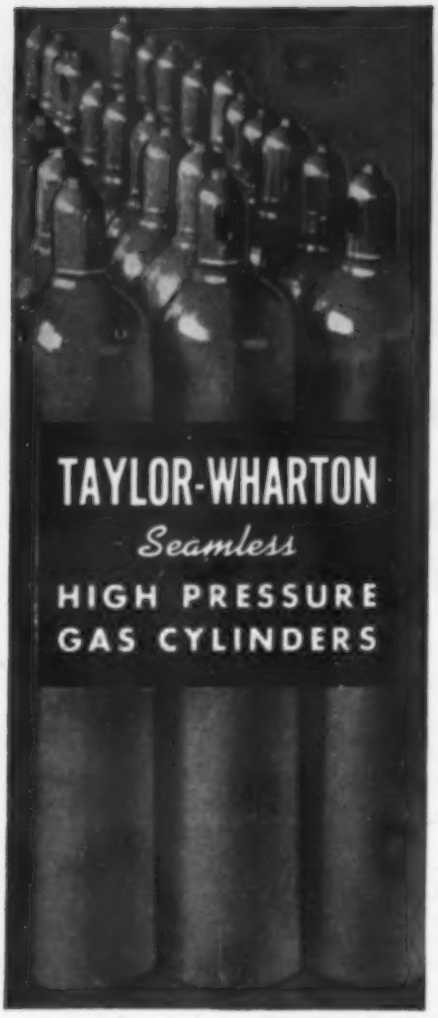
To the Editor:

Sir:—On page 75 of your February issue an item appeared with reference to the sale by the War Assets Administration of the plant at Salt Lake City. Since the article contains errors of fact, we are taking the liberty of writing you regarding it.

The Administrator did not ignore the American Potash Co., which was the high bidder, or indeed, any of the bidders. On the contrary, he arranged for a public hearing at which the three bidders and interested members of Congress and the general public appeared before him to present their views.

The decision to offer the plant to the J. R. Simplot Co., a small business concern located in the area, rather than to the large company, was made on the basis of the stated objectives of the Surplus Property Act which read in part as follows:

> Sec. 2(b) to give maximum aid in the reestablishment of a peacetime economy of free independent private enterprise,



Prompt service on your needs for

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Diameters up to 13"

• All Taylor-Wharton cylinders are made by the reliable "billet" process to the highest standards of manufacturing, testing and inspecting. Bottoms are integral (not spun), wall thicknesses are carefully controlled for uniformity. Complete, modern facilities to meet all your needs as to quantity, types and sizes. Let us quote on your requirements.

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MERCER BAND FILTRATION WASHING · DRYING Filters

Low-cost Efficient Continuous Suction Process

Model No. 50 Mercer Filter

PERFORMANCE—PROVEN FEATURES

Multiple washing zones. Evenly formed filtered cake. Varied thicknesses. Automatic cake discharge. Continuous filter medium cleansing. Low power consumption.

Arrange for Test

Mercer plant is equipped to conduct and report upon experimental tests made with samples of your materials. Inquire about this service.

"The Name that Carries Weight"

MERCER ENGINEERING WORKS, INC.
REPRESENTED BY MERCER-ROBINSON COMPANY, INC.
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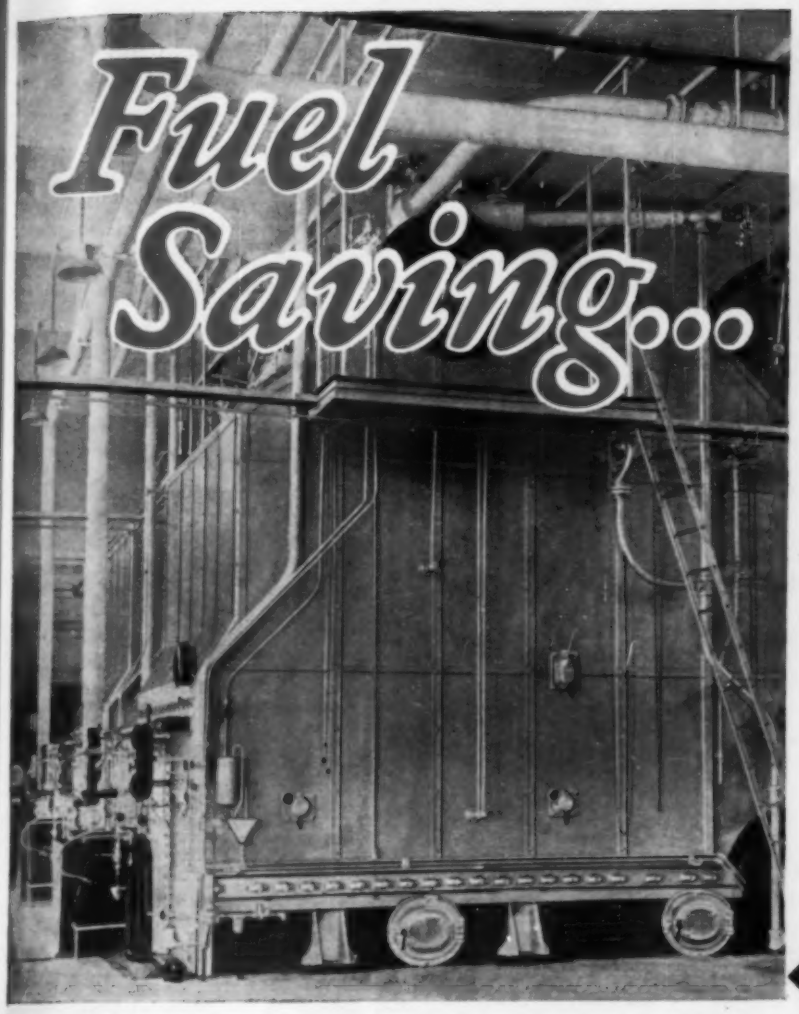
Sales Offices in Principal Cities



Fuel Saving... 25% with B&W "CUBS"*

This installation of B&W CUBS* consists of two oil-fired Type FF Integral-Furnace Boilers. Steam Capacity of each is 35,000 lbs. per hr. at 160 psi, 350 F.

How boiler plant modernization is helping to offset rising fuel costs is typically illustrated by the recent experience at a southern asbestos products plant. When *two* new B&W CUBS* replaced *six* old hrt units, a fuel saving of 20 to 25 per cent was immediately realized, along with substantially higher steam generating capacity.

Plant expansion shortly after the CUBS* went into service greatly increased steam demands. "We would have been unable to take care of the situation with the old units", reports the Company. "As it was, the new boilers ran away with the load. All in all, we are very much pleased with their performance, and feel that they are *one of the best investments we ever made*".

Any industrial plant requiring boilers of 10,000 to 50,000 lb. per hr. steam capacity can have the cost-saving benefits that are "wrapped up" in all B&W CUBS*. Three *different types* are available, each having distinctive features that make it the best choice for a wide variety of operating conditions. A B&W engineer will be glad to explain fully why they are such a good buy.

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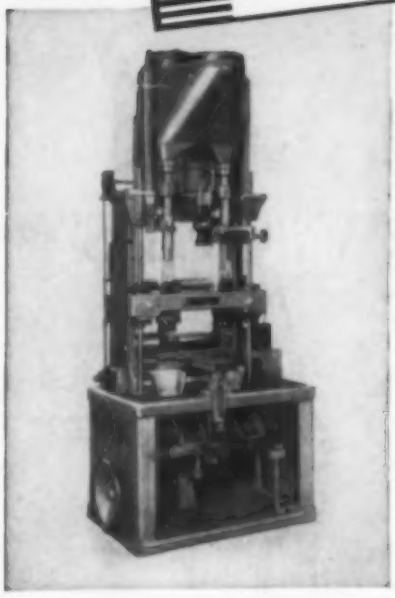

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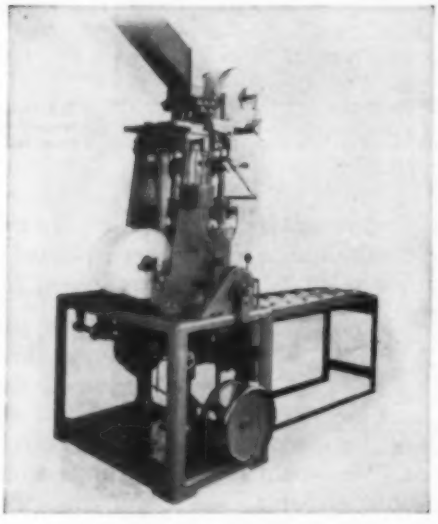

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the development of the maximum of independent operators in trade, industry, and agriculture, and to stimulate full employment;

"(d) to discourage monopolistic practices and to strengthen and preserve the competitive position of small business concerns in an economy of free enterprise;" (italics supplied)

Senator Elbert D. Thomas, commenting on this transaction, wrote to the administrator:

"I want to take this opportunity to heartily congratulate you upon this action. In my opinion it is not only equitable, and consistent with the legislative intent of the Act, but from a purely local point of view will prove pleasing to the people of Utah and the Intermountain area. . . .

"As Chairman of the Conference Committee responsible for the final formulation of the Surplus Property Act, I believe that I can appreciate the difficulties of the task which confronts you. If the policies which you have exhibited in the Kalunite case are a fair criteria of your attitude toward your duties, I am confident that there will be little cause for criticism of the job which you are doing."

In the case of the plant at Salem, Ore., the administrator's decision to offer the plant to the present operator also was in furtherance of the objectives of the Surplus Property Act. The present lessee qualifies as small business; he is producing a fertilizer material which is of great importance to the national economy; his present lease extends until next July and he has spent substantial sums in rehabilitating the plant. It would seem to be good business to offer the property to a current lessee if he is prepared to pay the fair market value and is otherwise qualified rather than to seek other possible purchasers and risk losing the sale and having the plant stand idle at the expiration of the current lease.

James S. Collins
Deputy Administrator
Office of Information and Advertising
War Assets Administration
Washington 25, D. C.

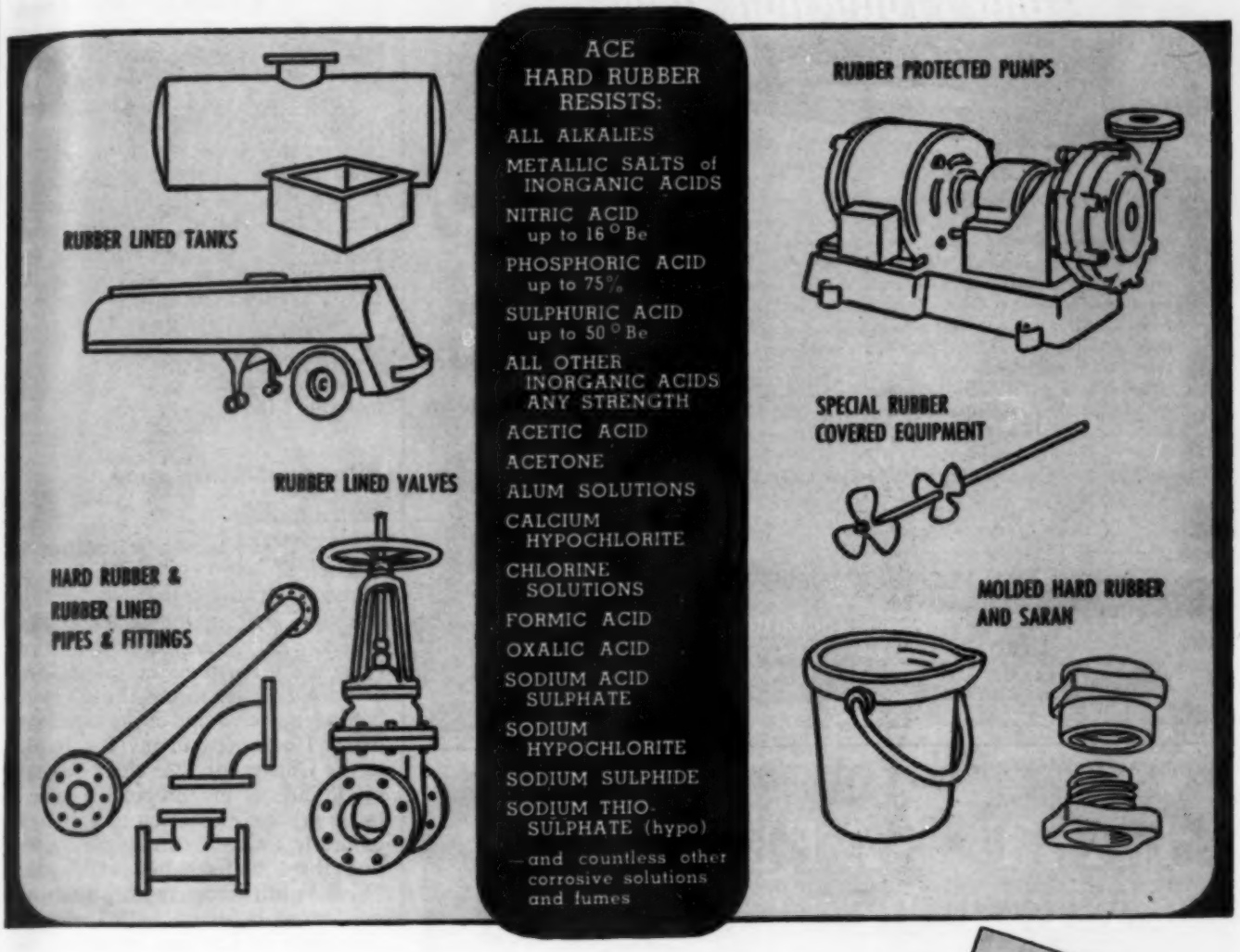
Mississippi Nitrogen

To the Editor:

Sir:—We wish to clarify the item appearing under "New Construction," page 324 of your February issue.

The proposed Mississippi fixed nitrogen plant will consist of three units: a synthetic ammonia plant, a nitric acid plant, and an ammonium nitrate plant. Net output of the fixed nitrogen plant will be 100 tons of ammonia and 110 tons of ammonium nitrate per day. This plant will be built to supply the nitrogen require-

Where Hard Rubber Saves



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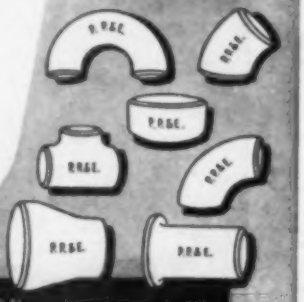

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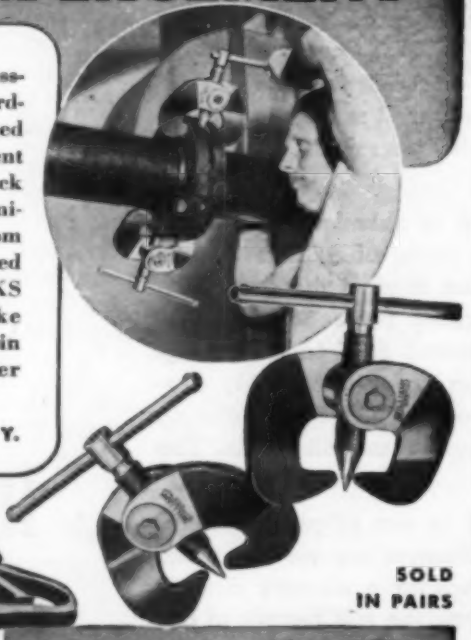

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ments of the soil, with the anhydrous ammonia being applied directly to the soil as explained in the excellent article in your January issue. The plant will be owned and operated by a corporation which has not yet been set up. No decision as to location has been made, except that it will be located somewhere in Mississippi.

The Mississippi Legislature recently appropriated $50,000 for the promotion of this project and the sale of stock in the proposed corporation—an unusual, but effective procedure. The bill authorizing this expenditure passed the Senate unanimously and had only one opposing vote in the House of Representatives.

ROBERT S. HAND
Mississippi Agricultural and Industrial Board
Jackson, Miss.

Bifurcated Curriculum

To the Editor:

Sir:—Your kindness in sending me a draft of your editorial foreword* dealing with my proposal for a departure from existing undergraduate engineering curricula is greatly appreciated. It is difficult within the space allowable for a "letter to the editor" to debate adequately some of the arguments which I advanced in my last Report to the Chancellor. The chief elements of novelty in my proposal I believe to be (a) the institution of a uniform or nearly uniform curriculum for the first three undergraduate years, and (b) a fourth undergraduate year having two main stems, both leading to a Bachelor of Engineering degree, but with very different objectives.

One senior year stem (which I call the "career" stem) would be designed to provide terminal engineering education. To this would be directed that large number of students who are benefited by a broad engineering education as a preferable background for ultimate managerial or supervisory, or sales and promotion, positions in industry or business; for careers in the military services; for teaching positions in secondary schools and technical institutes; for postgraduate work in business or other professions; and the like. This stem would provide a wide choice of electives, generally of a nontechnical character. It might well present an array including more economics, history, public relations, labor and management problems, marketing, statistical analysis, and the like. The graduates from this stem would come to look upon engineering education as a desirable preparation for a wide variety of careers.

The alternative senior stem (which I call the "professional" stem) would

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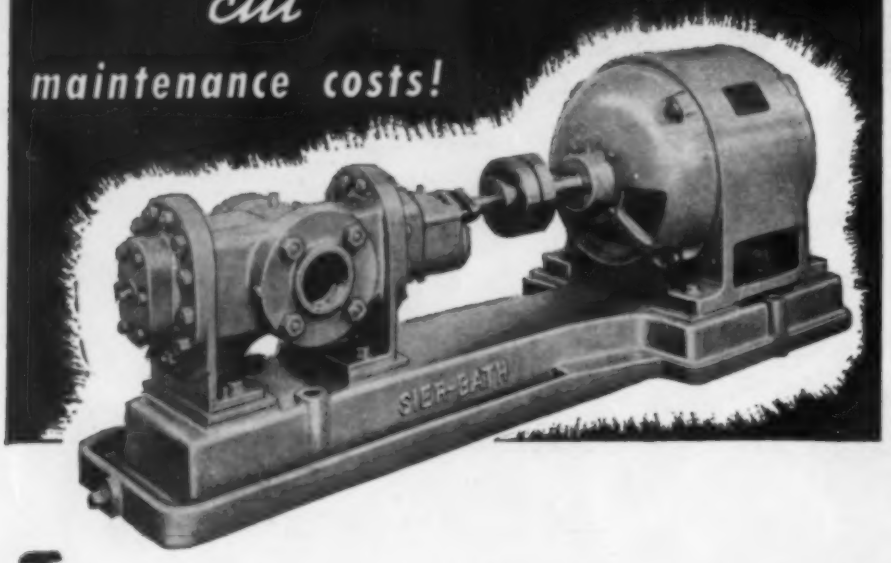

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be equally large in possible electives, but these would be mostly of a technical character, preparing for the several branches of the engineering profession, and generally entered into with the intention of taking a fifth year at the end of which the designated bachelor's degree would be given.

Many of those completing the "professional" stem and the fifth year would continue as graduate students for the master's and doctor's degrees. They would be those whose abilities and aptitudes fitted them for the more highly mathematical and scientific phases of engineering. These, on both the undergraduate and graduate level, I call the "professional" group as compared with those who, while equally gifted intellectually, found their abilities and aptitudes leading toward careers which, even if engineering in nature, were not of a highly professional character.

The proposal, of course, has some features of various programs now in effect, such as the one mentioned in your editorial, but I believe it to be substantially different from any one of these in specific objectives and in content. Only the brief news release giving the proposal in abstract has thus far appeared, and yet I have had many letters from engineering college administrators, from an arts college president, and from practicing engineers, indicating marked interest in and general approval of the idea.

THORNDIKE SAVILLE
Dean
College of Engineering
New York University
New York, N. Y.

* *See p. 95, this issue.*—Editor.

Hen or Egg?

To the Editor:

Sir:—I have just been re-reading your editorial in the January issue. I question whether either you or Chairman Eccles have considered everything in this business of increased productivity of labor helping to combat inflation. If increased production would mean a lowering in prices you would unquestionably be right. But won't you agree that we never have lowering of prices in good times, that prices stay up until the market goes to hell? As I see it, unless wages go up, which would mean at least the possibility of increased demand, the only result of increased productivity will be to bring on more quickly the increase in inventories which is bound to result in a depression.

PAUL M. GIESY
Bloomfield, N. J.

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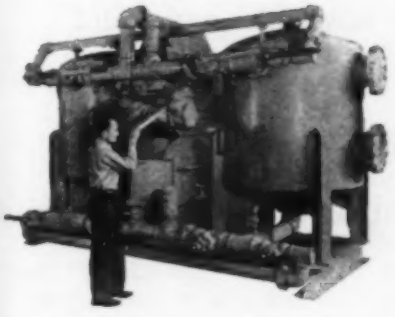

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NEWS FROM ABROAD

Special Correspondence

McGRAW-HILL *World News*

Italian government probably will approve the new construction requested by American firms . . . India is pushing work on a large ammonium sulphate plant at Sindhri . . . Australia is using a two-stage cooling system to remove water from city gas . . . Colombia is building an alkali industry, with some units as big as those in United States . . . Nylon fiber will be rolling out of Australian plants soon . . . Reds kick out head of Czech chemical industry as they take over country.

Italy Studies Plans For New Refinery Capacity

THE Italian Government has decided to build several new oil refining plants. It is expected to approve projects submitted by Anglo-Iranian, Standard Oil Co. of New Jersey, Caltex and Dr. Kind, former managing director of the Trieste oil refinery, together with their Italian associates. Royal Dutch Shell has submitted an application to increase crude charging capacity of the La Spezia refinery from 800,000 to 1,000,000 tons yearly. Socony-Vacuum has asked to increase the output of kerosene, lubricating oil and bitumen at their Naples refinery while smaller North Italian refineries would enlarge their plants to develop the output of refined petroleum products. The Caltex-Fiat refinery should have a crude oil charging capacity of 1,000,000 tons yearly. Dr. Kind may build a refinery having a crude charging capacity of 1,500,000 tons. All the largest plants should have catalytic cracking sets in addition to ordinary distillation.

In the Abruzzo region, methane gas resources have been discovered in about 89 sites at a depth varying between 1,000 and 1,200 meters. Italian geologists say such resources include about 3,000,000,000 cu. m. of gas.

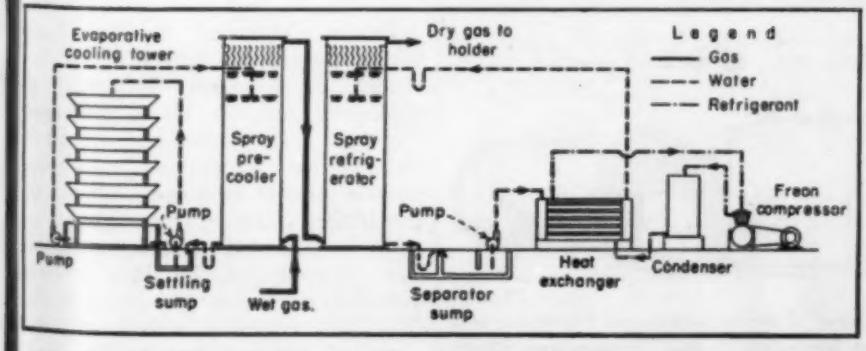
India Moves to Correct Nitrogen Shortage

FACED with an annual nitrogen shortage in agriculture of more than a million tons the Indian Government is taking all steps to speed work on the giant 350,000 ton per year ammonium sulphate plant now under construction at Sindhri, in Bihar.

The national budget for the seven and a half months ending March 31, 1948, has set aside more than $12,000,000 for the project, but this amount will be only a fraction of what the plant ultimately will cost.

Chemical Construction Co. and Power Gas Ltd. hold the major contracts for design, purchase and installation of plant. The construction of other components is being done by the Public Works Department. Contracts are to be let this spring for the installation of a water supply system which will deliver 12,000,000 gal. a day to boilers and process equipment.

The plant will make the sulphate by the gypsum process, with synthesis gas manufactured from coke. The coke-oven gas will also fire the kilns of a subsidiary cement factory which will utilize the calcium carbonate sludge from the fertilizer plant.



Spray cooling dries city gas at Adelaide, Australia. A Freon system is used in the second stage. Plant has a 2,000,000 cu. ft. per day capacity

Australia Using Two-Stage Cooling to Dry City Gas

TO PREVENT formation of rust in mains and meters, the South Australian Gas Co., Adelaide, is treating gas in cooling plants to reduce its dew-point and prevent deposition of moisture in the distribution system.

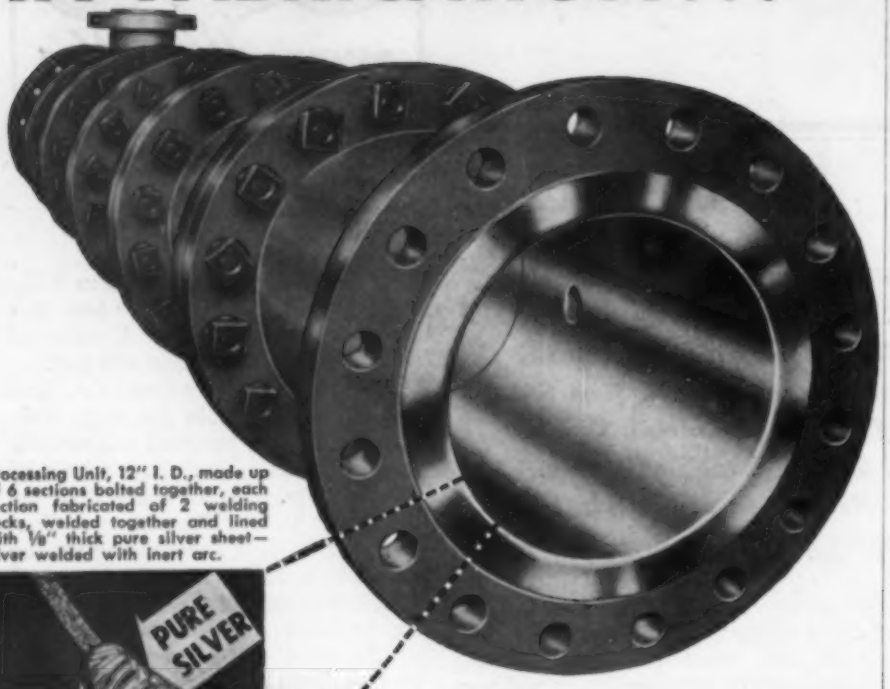
A steam-jet refrigeration plant is used at the company's Brompton works, but of particular interest is the new 2,000,000 cu. ft. per day Osborne dry gas plant which uses a Freon freezing unit in combination with a novel evaporation pre-cooler. The plant is entirely automatic in operation.

In addition to removing moisture from the outgoing gas, the spray cooling method employed affords a ready means of restricting its sulphur and ammonia content.

Experience in the operation of the older jet refrigeration plant indicated that it should be possible to reduce the dew point to within 2 deg. F. of the circulating water in a properly designed direct contact type of spray cooler.

This experience was utilized in the adoption of a precooling system as a reduction of only a few degrees in gas temperature resulted in a considerable lowering of the load on the more

PURITY and PRECISION IN FABRICATION...



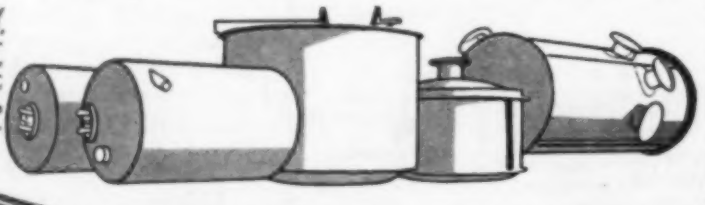
Processing Unit, 12" I. D., made up of 6 sections bolted together, each section fabricated of 2 welding necks, welded together and lined with 1/8" thick pure silver sheet—silver welded with inert arc.

Cross-section of Nooter-Weld before Grinding and Burnishing.

SILVER CLAD by the NOOTER-WELD PROCESS.....

Here's a good example of how the Nooter-Weld combines the properties of two entirely different metals — *heavy duty middle gauge steel* for pressure resistance and structural strength—with a pure silver for corrosion-resistance. The Nooter-Welds of the silver inert arc type (invisible because they are ground and buffed) are used for bonds and seam-welds. The steel is built up to pure silver without any dilution from the vessel wall to which it is bonded. This is essential to corrosion-resistance and to the successful performance of the unit. Nooter craftsmanship can always be identified by distinctive construction features—such as smooth, straight seam-welds—placement of fillets, etc., as well as precise fit-up.

Processing Equipment by Nooter—Converter Shell, 6'6" diam. 19'5" long—Hot Gas Filter Shell, 7'6" diam. 5'8" long—Sulphur Burner Shell, 8' diam. 17' long—Pump Tank, 9' diam. 6' long.



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costly Freon plant. For instance, in cooling 1 lb. of vapor-saturated gas from 80 deg. F. to 79 deg. F. the weight of water removed is 8.64 grains and the amount of heat 1.86 B.t.u. But when cooling from 46 deg. F. to 45 deg. F. the corresponding figures are 2.87 grains and 0.9 B.t.u. The pretreatment method is therefore particularly suitable for high-temperature conditions.

In the Osborne plant, the gas enters the bottom of the precooler and is sprayed with water from the evaporative cooling tower. It then passes into a second chamber to be sprayed with chilled water from the refrigeration unit. The chilled water is maintained at a predetermined temperature by a Minneapolis Honeywell Modutrol controller which regulates the speed of the D. C. motor driving the compressor by varying the resistance of the shunt field.

Design of the evaporative cooling tower is based on a paper by G. Russel Nance in the *Transactions* of the ASME for November 1939. The results in practice have demonstrated the soundness of the design, according to the chief engineer of the South Australian Gas Co.

However, effectiveness of this type of cooling tower depends very largely on the relative humidity of the atmosphere. The tower is highly suitable for conditions in South Australia where high summer temperatures are accompanied by relatively low humidity. At first some trouble was experienced with Algae deposits on wetted surfaces. This was overcome by addition to the water of small amounts of oil stripped from the gas in the dry gas plant.

Chemical Engineering thanks the National Gas Association of Australia for making available an unpublished paper by Mr. S. R. Preston, chief engineer, South Australian Gas Co., on dehydration practices at the company's Adelaide works.

Colombia Expands Its Alkali Industry

PLANS announced in New York jointly by representatives of the Instituto de Fomento Industrial of Colombia and the H. K. Ferguson Co. will give Colombia an alkali industry with production units comparable in size to some of those in the United States. The original program had limited production capacities. According to Dr. Juan de Dios Ceballos, director of the Instituto the new soda ash plant will have a capacity of 100 tons per day, the lime-soda caustic soda plant, 25 tons per day, and the electrolytic chlorine

isn't that the Mathieson Plant?

"It's one of them, Mr. Jones—the Niagara Falls plant."

Yes, Mr. Jones and there's another at Saltville, Va., to serve the southeast, and a third at Lake Charles, La., serving the southwest. With three plants, Mathieson offers triple flexibility in deliveries of caustic soda. Call it three sources of supply. That's why weather, breakdowns, railroad or labor conditions seldom keep Mathieson from making prompt deliveries.

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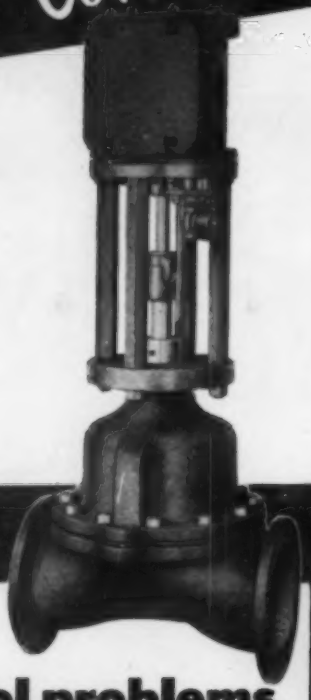

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plant, 5 to 10 tons per day. The Colombian salt industry will be expanded to 200 tons per day.

The new development is located near Bogota in the area of the Zipaquira salt mines from which the brine will be pumped eight kilometers to the plant site. The cost of the development is estimated at 15,000,000 pesos (Colombian) which is approximately $8,700,000 in the U. S. currency.

Other well-known Colombians participating in the development include Dr. Rafael de la Calle, director of soda plants for the Instituto, Dr. Carlos Gomez, director of salt properties for the Bank of the Republic of Colombia, Dr. Benjamino Alvarado, geologist for the Instituto and Sr. J. P. Gardenas, attorney for the Bank of the Republic. At the New York meeting these Colombia industrialists pointed out several reasons for launching the new industry in Colombia. First is that the government is committed to a program of industrialization and an alkali industry is one of the basic steps toward establishing other industries. The second reason is that the geographical location of Bogota, high in the mountains, makes transportation costs on finished products prohibitive. It is more economical to manufacture on a small scale at increased production costs than to import at lower U. S. costs plus high transportation charges. References were made to soda ash selling for as high as $500 per ton delivered in Bogota. Still another reason involves currency exchange considerations which make it desirable for the Colombian government to possess its own basic chemical industry.

This project is being designed and built under the direction of the Export Division of the H. K. Ferguson Co. in New York. R. C. Smith is manager of the Export Division and the plant design is under the direct supervision of A. L. Campbell.

Nylon Fiber Plant Planned For Australian Firm

THE Imperial Chemical Industries of Australia & New Zealand (ICIANZ) is seeking new capital to provide finance for the development of plastics and other chemical lines. For the time being, £2.5 million of new shares will be issued, but ICIANZ ultimately shoots for £7.5 million to double its present authorized capital.

The British combine plans to pioneer nylon extrusion in Australia. Initially the manufacture will include filaments for brushes and tennis rackets. Plans are also in hand to produce year.

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The kind of air a man works in has a lot to do with how much work he can turn out.

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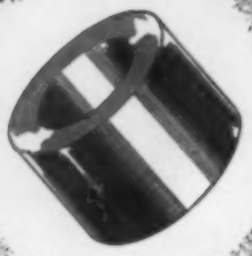

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polyvinyl chloride. A urea formaldehyde plant started last year.

Extensions to the alkali plant at Osborne, South Australia, are slowly getting under way. Work on extending and mechanizing the explosives factory at Deer Park is also proceeding.

ICIANZ executives stated that shortages of manpower, fuel and raw materials, coupled with a surfeit of industrial disturbances, have been restricting production. But ICIANZ's consolidated net profit last year was 20 percent above the previous year's.

REVAMPED CZECHOSLOVAK CHEMICAL INDUSTRY IS GEARED TO RED ECONOMY

The output of phosphate fertilizers has shown a marked increase during the past three months. Total production in 1947 was 343,645 tons—only 90 percent of the planned figure. Production was undoubtedly held back, after agricultural demands have been met, so that sulphuric acid could be switched over to the metallurgical industry.

The output of nitrogenous fertilizers seems to be the most satisfactory sector of the chemical industry. In 1947 132,383 tons were produced, 26 percent more than expected. The January output of 14,578 tons shows the trend is continuing.

Sulphuric acid production, during 1947, amounted to almost exactly the planned figure, 191,880 tons, despite repeatedly interrupted production, caused by obsolete plant, earlier in the year.

In December, output of soda ash reached 7,893 tons, the highest output since the beginning of the year, although the total figure of 89,477 tons for the year was about 4 percent less than that planned. January output of 8,541 tons seems well up to expectations. The export of soda ash was suspended at the end of December, because of shortages on the home market. About 10,000 tons annually were being shipped to South America.

The output of bichromates had reached 866 tons by the end of November, only 75 percent of the planned figure for the 11 months.

A high rate of absenteeism and a number of technical breakdowns in one important factory in the Czech

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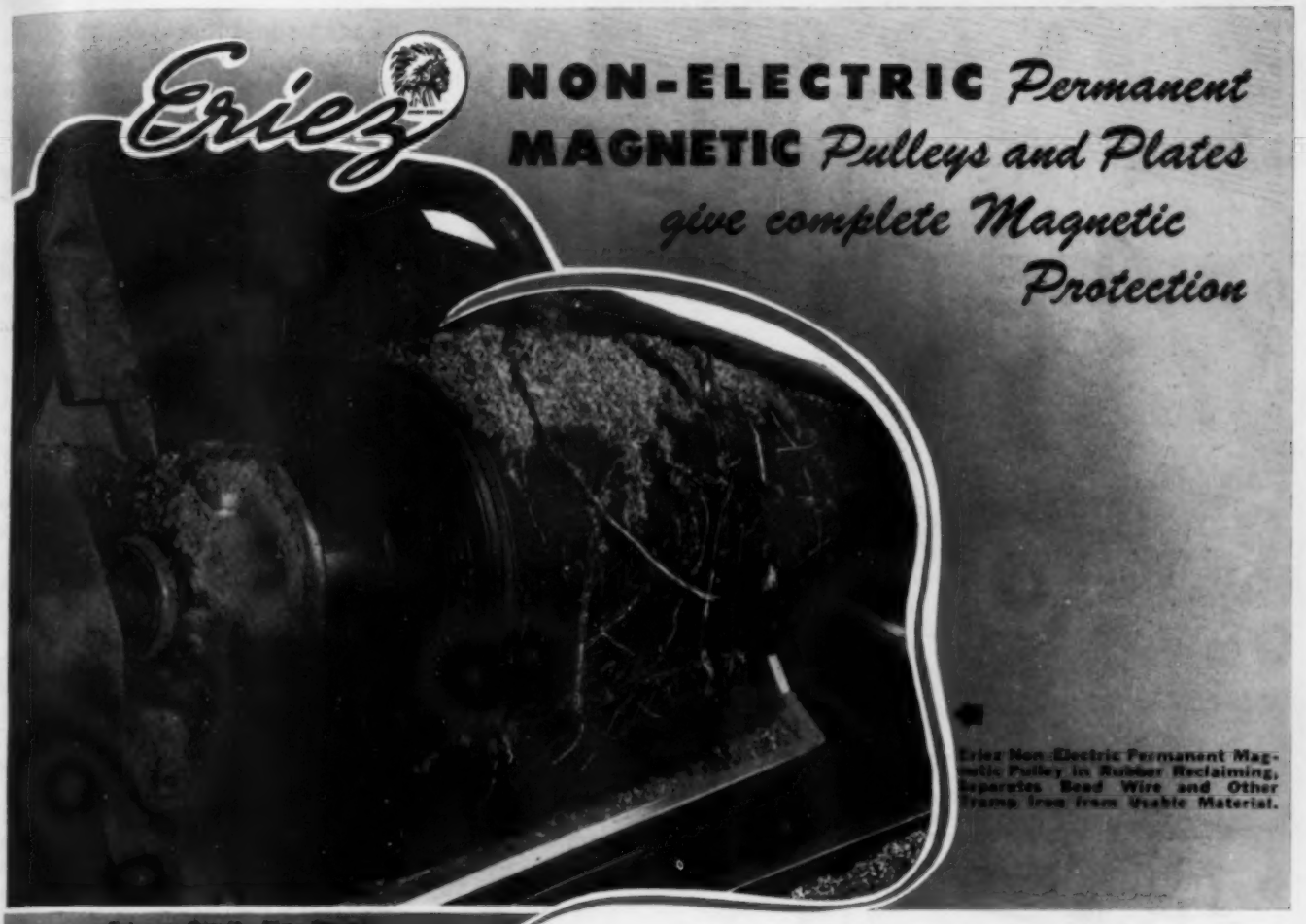

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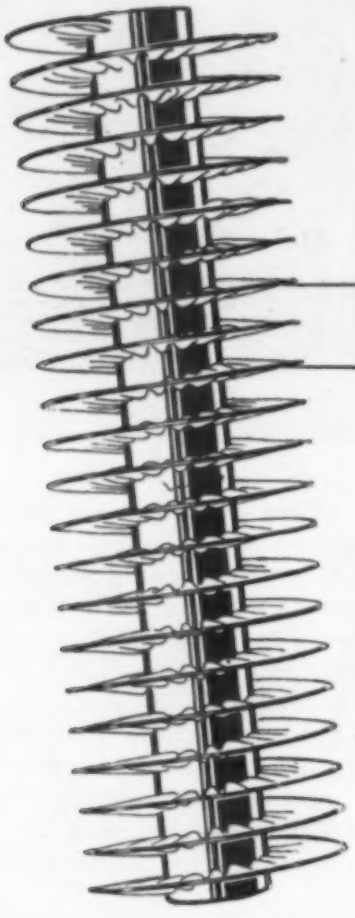

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lands has held back the production of artificial silk. Output for 1947 was 4,382 tons, 7 percent less than the planned amount. The January production of 424 tons is more promising, mainly due to the good efforts of the Svit (Bata) factory located in Slovakia.

Shortage of raw materials continues to hold back production of artificial fibers. Slovakia has more natural resources and is thus better provided for than Bohemia and Moravia and production in that part of the country is slightly above the planned amount. Production for the Republic in January was 1,249 tons or 91 per cent of planned output.

Output of ammonia and sodium hydroxide seems to be well up to the mark.

Soap is Scarce

Lack of fatty acids has seriously held up the production of soap and soap powder, and the situation does not seem to improve. During 1947 only 70 percent of the expected amount of soap was turned out.

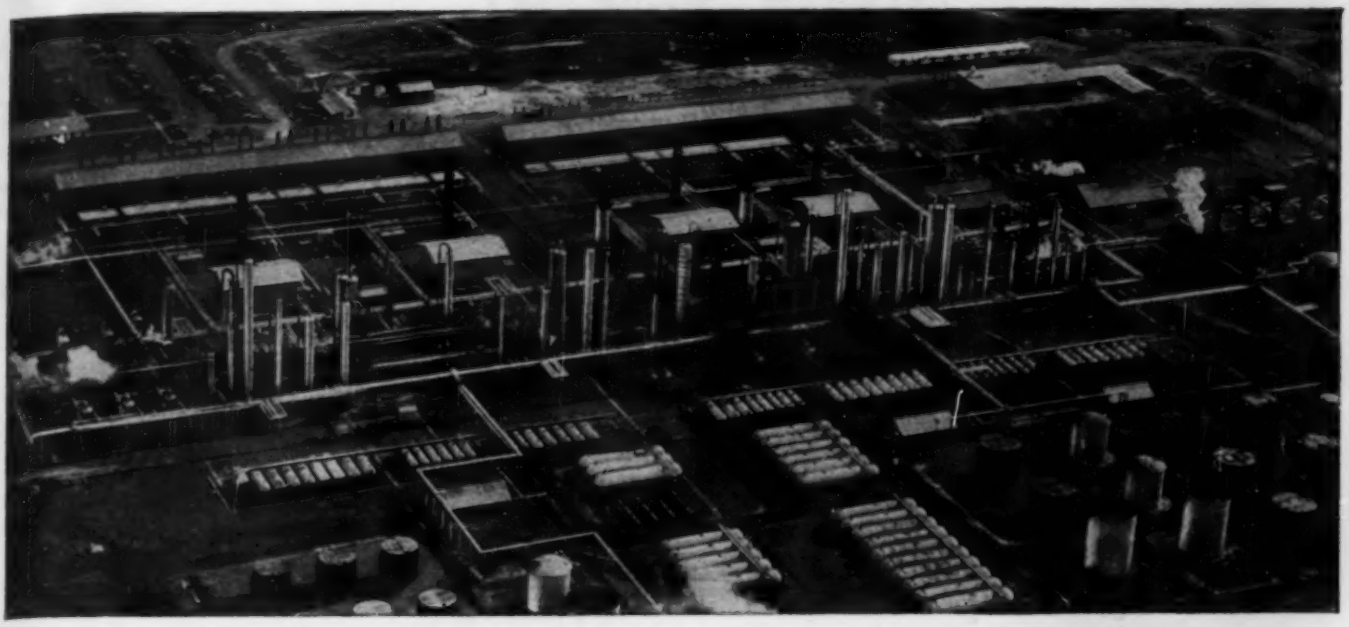
In February the construction was completed on the first modern long-distance gas main in Czechoslovakia. This main extends from the Stalin Synthetic Fuel Works at Zaluzi near Most, to Prague, as well as the industrial districts of Northwestern and Central Bohemia. The laying of the gas-main has taken two years. The gas is a byproduct from the manufacture of synthetic gasoline.

The General Director of the Stalin Synthetic Fuel Works, Ing. Svitavsky, recently announced that his concern had arranged for the delivery of certain byproducts to the Soviets. These exports, he said, would be extensive enough to cover a substantial amount of the wheat supplied to Czechoslovakia by the USSR.

Artificial gut is a valuable export for Czechoslovakia. This gut, which is extensively used in the sausage-making industry, is made in Korenov, North Bohemia, from hide waste. It is porous and sterile and will not decay, and its great advantage is that it can be turned out in any size desired. During the first half of 1947, 8.5 million meters were manufactured. About half of this was exported, mostly to the dollar and sterling area according to available data.

Among those important officials who have been asked to resign or have been given extended leave, following the recent change in government in Czechoslovakia, is the former General Manager of the nationalized chemical industry, Dr. Karel Martinek. It is claimed that Dr. Martinek, although an expert businessman, was not an

LOOK TO CELANESE



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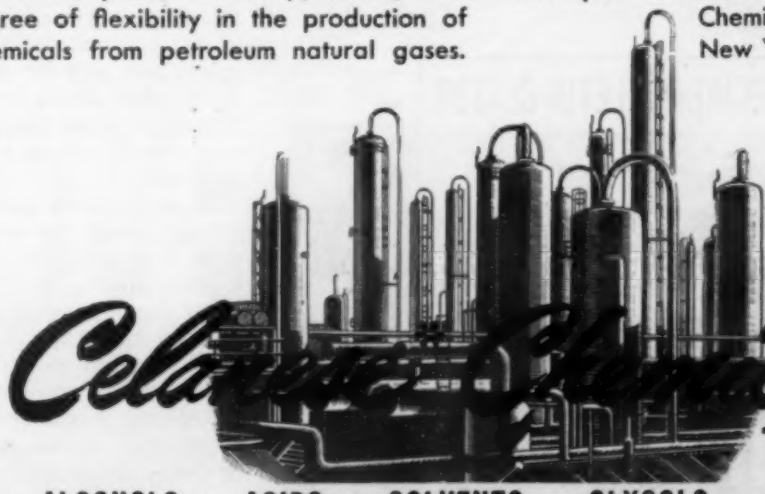
More than fifteen years of Celanese research in the field of petroleum chemistry have provided the Celanese Chemcel plant, at Bishop, Texas, with a high degree of flexibility in the production of organic chemicals from petroleum natural gases. This flexibility has enabled Celanese to meet the constantly changing needs of chemical markets for basic organic chemicals and important new compounds.

New chemicals are continuously being developed in the extensive Celanese laboratories. Specifications on new products as well as data on a regular list of Celanese* organic chemicals are available on request. CELANESE CORPORATION OF AMERICA, Chemical Division, 180 Madison Ave., New York 16, N. Y.



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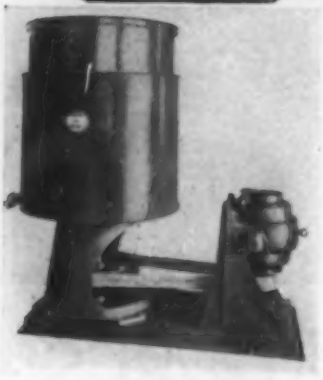

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organizer or chemical man. Before the recent additions to the nationalization law, the nationalized sector accounted for 72 percent of the chemical industry.

The Fats Factories, National Corp., are to build a new factory in Bratislava, Slovakia, for the production of artificial fats. It will be the largest of its kind in Europe.

Brazil Plans New Petroleum Regulations For Refiners

AMERICAN oil companies in Brazil are cold toward a projected new petroleum law which would limit refining and transportation of Brazil's is oil for domestic use to Brazilian firms.

While American oil men decline to be quoted and insist they have put no pressure on the government to modify the plan, they hold in general that exploration and drilling for Brazil's supposed petroleum under the project's limitations would probably not be a sound venture for them.

Essentials of the project, now in Congress' hands, are: (1) Exploitation of Brazil's oil is a government responsibility. (2) Both foreign and domestic firms may be authorized to seek out and drill for Brazilian oil, but only companies with at least 60 percent Brazilian voting stock may refine and transport it. (3) Foreign as well as domestic companies may be granted the right to market national petroleum for local sale. (4) Exportation would be permitted to either foreign or domestic firms, but only after certain conditions of national supply are met.

Some foreign oil men look at it this way: if the process of handling petroleum, from exploration to delivery for use, is considered as a straight line, foreign firms find themselves at the beginning and the end of the line, with Brazilian firms and the Brazilian government in the middle.

Since the government's National Petroleum Council would fix the prices at which the wells would sell crude, and also the prices at which the product could be marketed, foreign oil men say they would have no guarantee of getting a return on their investment.

Through many generalized clauses strung through the lengthy document, they fear, the National Petroleum Council could, if it wished, hamstring them completely and even take over what they had begun to exploit, at its own figure. They hold that the conditions on exportation are subject to varying interpretations and controls which would make exportation of doubtful interest to them.

The code had been under debate

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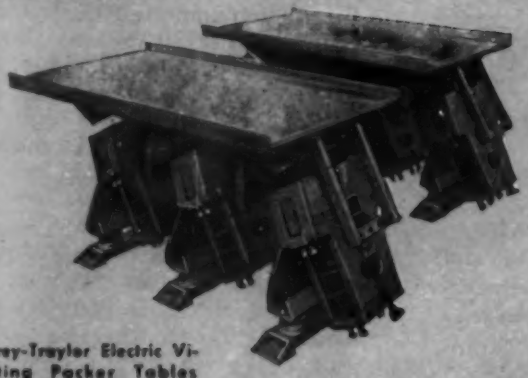
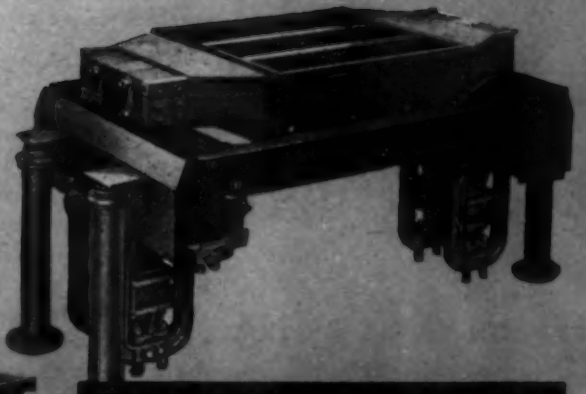


Jeffrey-Traylor Electric Vibrating Packer Tables which impart conveying motion to molds

Heavy duty Jeffrey-Traylor Electric Vibrating Grizzly Knock-out unit for removing plastic from barrels



Jeffrey-Traylor Electric Vibrating Packer Table adapted to molding operations of various materials. Especially valuable for settling molten chocolate into bar molds.

We will be glad to go into detail about the worthwhile economies to be obtained with the application of Jeffrey-Traylor equipment (Patented) to your processing and packing operations. In the meantime send for our new J-T catalog No. 750.

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Although basically the same, the modern, 1948 models of the "18 and 8" stainless steels have been given a lot of PLUS values by recent metallurgical experience.

The analysis of Lebanon's Circle L 22XM (left) is a typical example. In addition to increases in the percentages of chromium and nickel, approximately 2.25% of molybdenum is added. It enhances the general corrosion resistance to many chemicals and is an important PLUS value to many manufacturers—perhaps to you.

If corrosion is one of your troubles, your metallurgists and design engineers should have a complete file of the new Lebanon Data Sheets describing these alloys. Write for them today.

LEBANON CIRCLE L 22XM

NOMINAL ANALYSIS

Carbon Max.	0.07
Silicon	1.25
Manganese	0.75
Chromium	19.50
Nickel	10.00
Molybdenum	2.25

NOMINAL PHYSICAL PROPERTIES

Tensile Strength	82,000
Yield Point	42,000
Elongation in 2"—%	50
Brinell Hardness	160

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CIRCLE L

in public meetings and the press for many months. Some army men had demanded outright government operation—from exploration to marketing. The Communists, against anything the United States might like, made strange bedfellows for those military men. Some government leaders had wished to let foreign companies carry out all those operations, under certain restrictions, because they believed that otherwise nothing could be done.

Whether Brazil will ever become a big petroleum producer is purely speculative. The country has several areas which petroleum geologists consider good bets, but the only one which is now producing—and on a very small scale so far—is the field near São Salvador, state of Baia, where estimated reserves are around 17 million barrels.

Gasoline and oils form one of Brazil's top imports. They cost the country nearly 50 million dollars in the first nine months of 1947.

Mexico Will Build Ammonium Sulphate Plant

A $10 million ammonium sulphate plant, the first to produce nitrogen fertilizers in Mexico, will be constructed near Mexico City in the immediate future. Construction has been assured through the recent granting of a $6 million credit from the Export-Import Bank in Washington, D. C.

The $6 million credit will be made to National Financiera, S. A., a financial agency of the Mexican Government, for the purchase of U. S. equipment, materials and services required for construction. The other $4 million will be supplied by Guanos Y Fertilizantes, S. A., wholly owned by Nacional Financiera, and will go for Mexican equipment, materials and labor as well as working capital.

Guanos Y Fertilizantes will also build and operate the plant, which is scheduled for completion early in the spring of 1950. However, Chemical Construction Corp., New York, will have continuing responsibility for final design, supervision of plant construction, and the technical supervision of production for at least three years.

Production capacity of the plant will be 70,000 short tons of ammonium sulphate annually (based on 350 days' operation). This is enough to free Mexico from dependence on imported nitrogeneous fertilizers. The ammonium sulphate will be produced from ammonia synthesized from natural gas and sulphuric acid manufactured from raw sulphur.

Natural gas will come from a pipeline which Petroleos Mexicanos, the Mexican Government Oil Monopoly,

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200 lb. UNION BONNET BRONZE GATE VALVES
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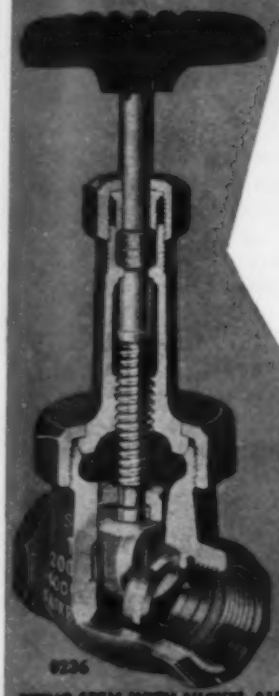

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RISING STEM WITH NICKEL ALLOY WEDGES AND RENEWABLE NICKEL ALLOY SEATS. SIZES ½" TO 2".

because . . . the specially designed hard nickel alloy seats and wedges provide the ideal combination for corrosion and erosion-resistance that extends valve life, reduces maintenance costs, eliminates service interruptions.

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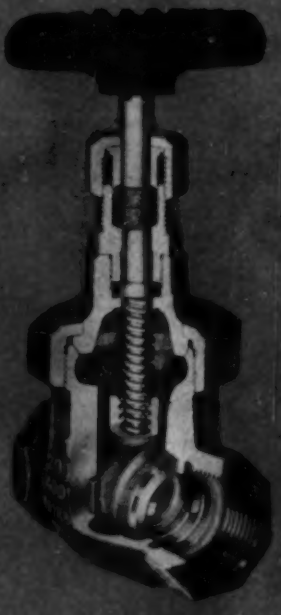
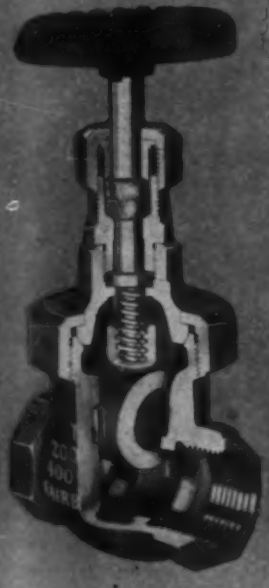


because . . . the Union Bonnet Construction permits the easiest and quickest valve dismantling for inspection, cleaning, or replacement of parts. A heavy octagonal union nut and radial bonnet joint assure pressure tightness and perfect alignment of all parts.

because . . . stuffing boxes are large and deep . . . filled with moulded asbestos packing and fitted with a heavy, brass follower gland. Gland is held tightly against packing by wrought brass packing nuts. Valve can be repacked under pressure when wide open.



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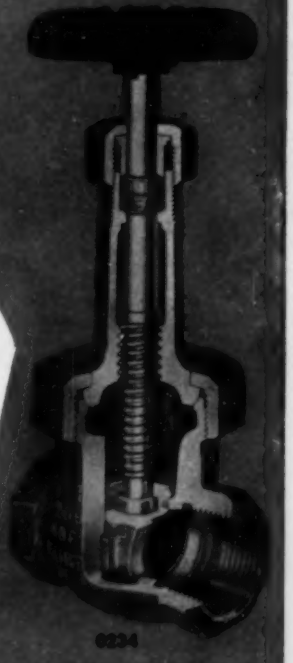
because . . . wedges are held in proper alignment by machined guides in the wedges and heavy cast ribs in valve body. Bodies and Bonnets are special cast steam bronze with reinforcing ribs for extra safety under pressure and resistance to operating stresses.



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For complete information about this outstanding line of valves write for Bulletin V-230. The Fairbanks Company, 393 Lafayette St., New York 3, N. Y.; 520 Atlantic Ave., Boston 10, Mass.; 15 Ferry St., Pittsburgh 22, Pa.; 748 M&M Bldg., Houston 2, Texas.

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S

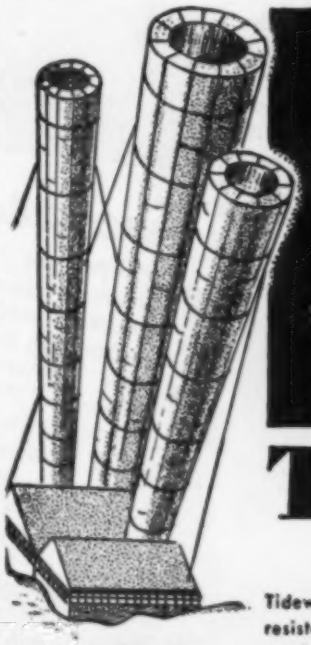
is now constructing from the Poza Rica Field to Mexico City and vicinity for industrial consumers. Sulphur will be obtained from the desulphurization plant which Petroleos Mexicanos is to erect at Poza Rica to clean the gas.

The credit will bear interest at the rate of 3¼ percent per annum, be unconditionally guaranteed by the Mexican government, and be payable in not more than 20 semi-annual installments beginning June 30, 1950.

CURRENCY PROBLEMS OVERSHADOW BRITISH PLANS TO EXPAND PRODUCTION OF CHEMICALS

Costs and prices are worrying British manufacturers. Chemical exporters have found that outside of essential key products, prices once again matter in the foreign market. In hard-currency areas strong American competition has been noted. British manufacturers in a position to judge developments in both countries have told the government that the prices of most U. S. goods have risen far less than comparable producing costs in Britain. This is attributed to the greatly increased volume of production in the States. It has given rise to renewed demands for another look at the British export program. A healthy export trade cannot be maintained unless it is based on a large home market, which must contribute substantially to the cost of overheads.

Meanwhile the export trade in chemicals continues to improve. The month of January witnessed an increase by one-seventh over December, and the improvement was maintained during February. Most recent gains are due to larger shipments of bulk chemicals which are in short supply. Soda ash is being shipped abroad to meet urgent demands while the domestic glass industry goes short, with the result that glass containers have to be bought abroad to supplement the insufficient home supply. This may be an exceptional case, due to the insistence of foreign negotiators in recent commercial discussions on larger shipments of British key chemicals. But British users of chemicals have begun to question the wisdom of earning dollars by exporting basic chemicals when domestic consumers have to go short as a result and may be forced to cut down their exports. Authorities realize this but have not found an answer,



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Naturally Resistant
TO ACIDS, ALKALIES AND DECAY

Tidewater
RED CYPRESS

Tidewater Red Cypress serves better and lasts longer. It's natural resistance to acids, alkalies, etc. insures long and satisfactory results when used in vent stacks, pickling troughs, electroplating vats, etc. It's use under these conditions truly confirms its claim to being "The Wood Eternal".

If you have a particularly perplexing problem let us help you solve it. We invite inquiries concerning all types of tanks and vats . . . fully fabricated or partially fabricated.

Tidewater Red Cypress "The Wood Eternal"

FLEISHEL LUMBER COMPANY

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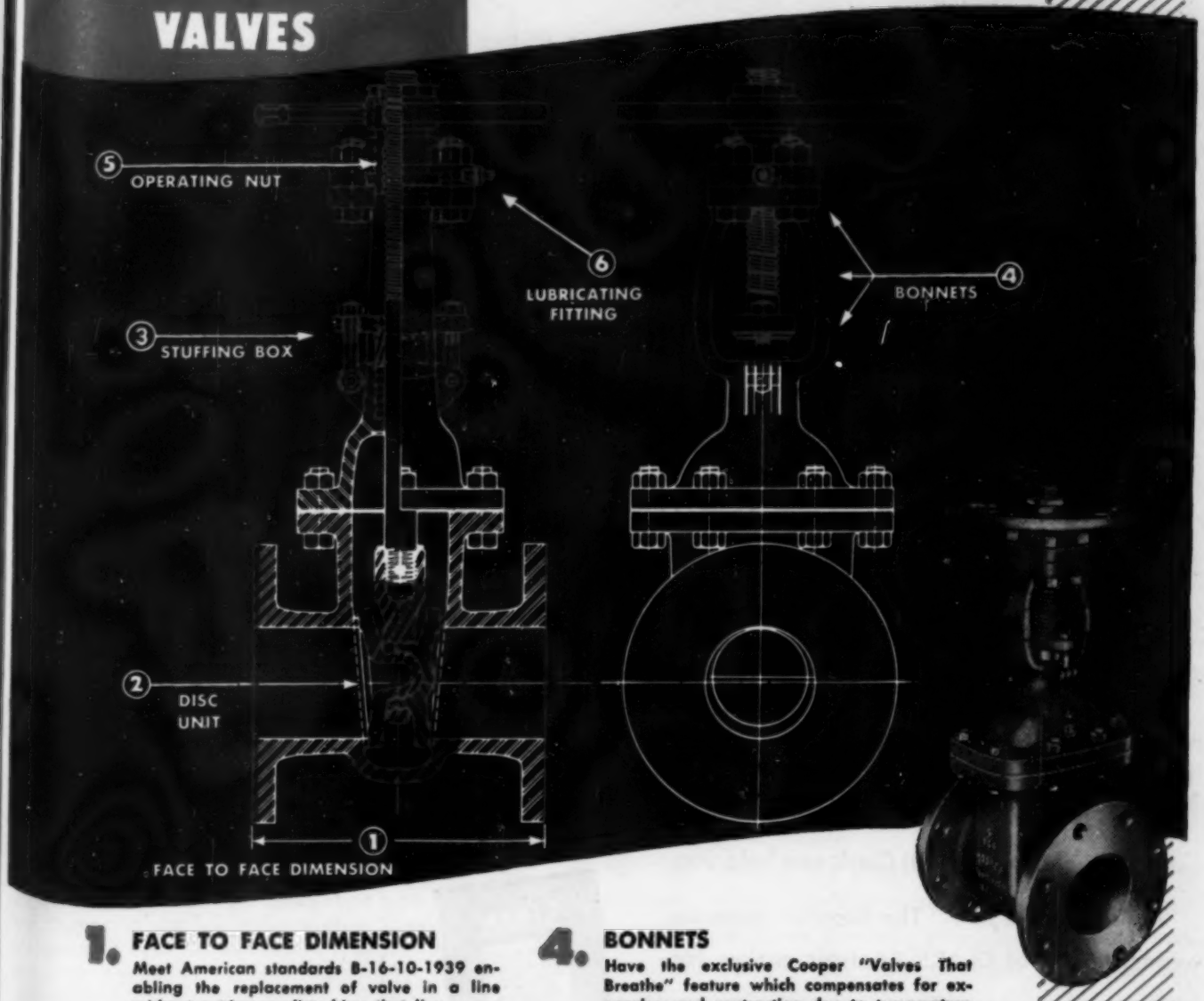
COOPER CERTIFIED STAINLESS STEEL VALVES

have these unique design features



1. FACE TO FACE DIMENSION
Meet American standards B-16-10-1939 enabling the replacement of valve in a line without cutting or disturbing that line.

2. DISC UNIT
Adjusts itself to the seats in the valve body regardless of angle. Positive sealing insured on the upstream or downstream sides of the discs.

3. STUFFING BOX
More adequate in depth to insure tightness and maximum packing life.

4. BONNETS
Have the exclusive Cooper "Valves That Breathe" feature which compensates for expansion and contraction due to temperature changes without damaging the stem or operating nuts.

5. OPERATING NUT
"Replaceable Operating Nut" eliminates line shut down or breaking of Bonnet Joints.

6. LUBRICATING FITTING
Feeds lubricant to operating nut insuring ease of operation.

Sold thru Leading Stainless Steel Distributors

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Specialists in Corrosion Resisting Stainless Steel . . . for a Quarter of a Century

It Pays to Standardize on Clark–the Complete Line of Steam Traps!

YEARS OF EXPERIENCE PROVE THAT CLARK CONTROLS

Last Longer
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If your production costs have been going up (and whose haven't) Clark can help you "hold the price line." The heavier, stronger construction of CLARK Controls makes for longer life and less frequent replacement. Our Engineering Department stands ready to help you on all fluid control problems.

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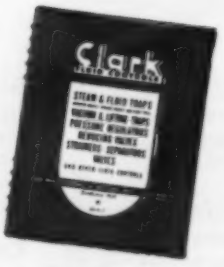


Write today for this free, helpful guide to more economical controls for your oil, steam and air lines.

THE CLARK MANUFACTURING CO.
1833 East 38th Street • Cleveland 14, Ohio

Clark
FLUID CONTROLS

though they are making special efforts to induce foreign countries to accept more finished products and lift their restrictions on imports of less essential products.

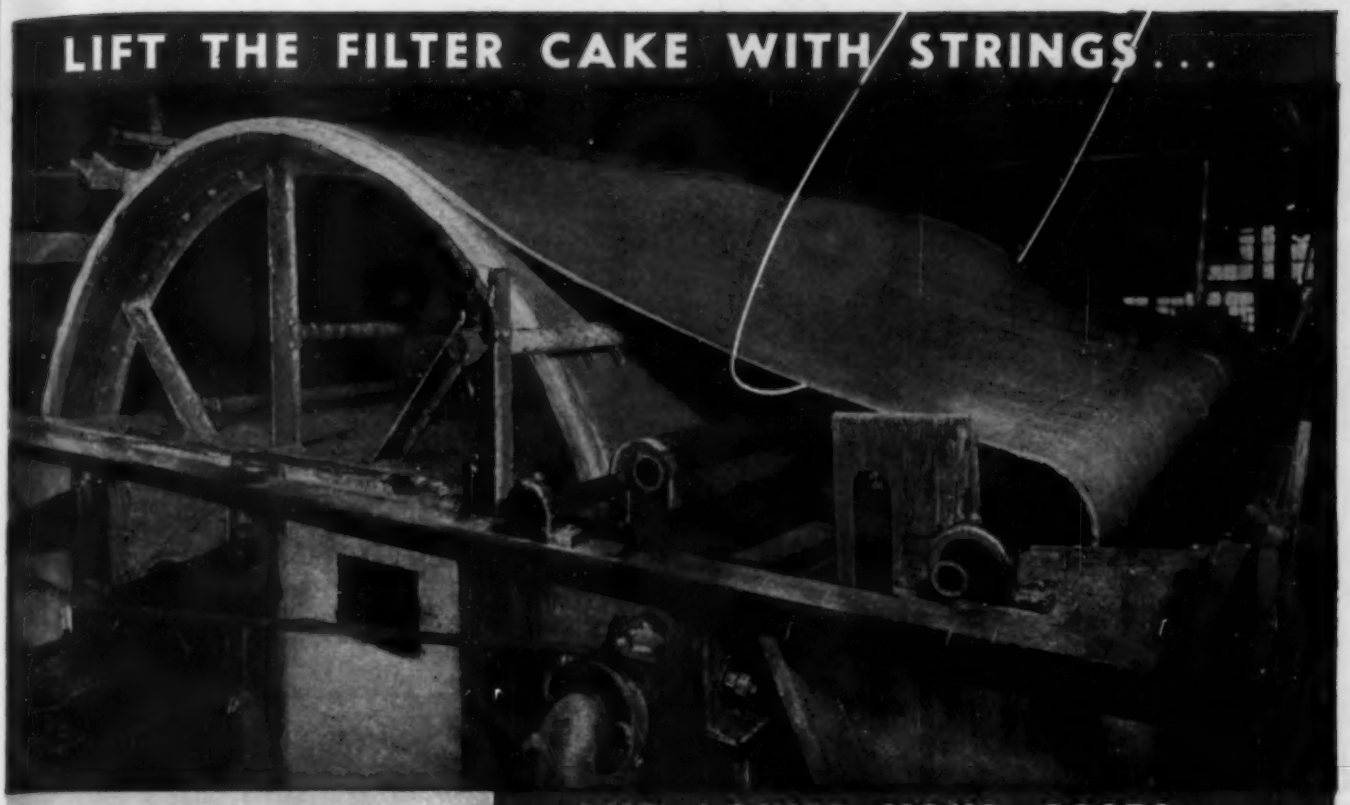
To deal effectively with the price problem at home, the British Government has imposed a price ceiling on most manufactured goods which were still free of price control. In future toilet preparations, medicinal products, ready-made paints, etc., must not be sold at prices above the lowest charged in December, 1947-January, 1948. The government has approached representative industrial organizations for suggestions as to how further price advances can be avoided and excessive prices be reduced. The chemical industry is unlikely to be affected greatly by this new campaign for price stability as most important chemicals are under direct price and distribution control. Employer-worker relations are good in the British chemical industry, but this new regulation is bound to impose a serious strain on industrial peace.

Price Increases

Price of sulphuric acid has had to be raised (with effect from March 1), and the price tendency generally was upward in the past few weks. Chemical manufacturers are feeling doubtful about a price standstill if world market prices of raw materials continue to increase. The new plant which has to be brought into operation in this and the next few years to replace worn-out equipment and add to the available capacity is three times as expensive as a similar plant installed before the war. Lower interest rates and the expectation of full-capacity operation may partially offset the effect of higher capital costs on calculated producing costs per unit of output, but even so manufacturers feel that some allowance is due for higher depreciation and obsolescence provisions required in the changed conditions.

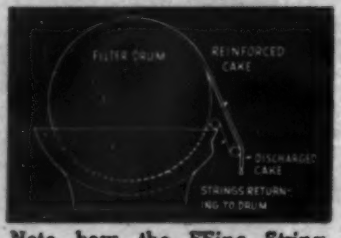
On the other hand, it has been noted that government departments are now more helpful when official assistance is required to ensure that additional production facilities are brought speedily to the productive stage. Output statistics for the past year which are now coming in from various sections of the chemical industry indicate that in spite of full capacity operation the increase in output has been disappointingly small in the case of many fuel products. This is largely due to the fuel crisis early last year, a temporary factor, but also to short interruptions due to delivery delays, power cuts, and essential plant repair and overhaul, which can hardly be avoided in existing circumstances. Further output in-

LIFT THE FILTER CAKE WITH STRINGS...



AND LOWER YOUR COSTS WITH THE FEinc FILTER

STRING DISCHARGE



Note how the FEinc String Discharge reinforces the filter cake and removes it from the filter drum in one continuous, easy-to-handle sheet.

BETTER WASHING

A long washing arc, with thorough flooding of the cake followed by a long dewatering cycle, results in better chemical washing.

OTHER FEATURES

Compression Drying Mechanism
Continuous Filter-Drum Dryer
Repuddling Process for Starches
Scoring Device for Feeding Preformed Cake to Continuous Dryers

You don't have to put up with frequent cloth changes, "blow-back", wire winding, or scraper-clogged filter cloths that are too heavy for good continuous filtration.

With the FEinc continuous rotary vacuum filter, the String Discharge lifts the thoroughly dewatered filter cake gently from the revolving filter drum—in one continuous sheet with no scraping...

As the filter rotates, the filter cake is deposited over a series of closely spaced, endless strings that pass around the drum. The strings reinforce the cake as it comes off the drum, and support the cake to the small-diameter discharge roll where the strings are disengaged and passed back to the filter drum.

FEinc filters are normally available in sizes from 9 to over 500 sq. ft. filter area. Plain designs handle the "easy" jobs, and any combination of the exclusive FEinc features can be adapted to your special filtering, washing, drying, and cake-handling problems. Call in Filtration Engineers Inc. to help you plan for better continuous filtration.

Bulletin 101 rushed on request.

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Based on the successful experience of leading American businesses using Filtrol* products, you too may have an opportunity for perfecting present products or processes . . . or advancing your pioneering efforts.

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CATALYSTS • ADSORBENTS • DESICCANTS

crease therefore depends on new plant coming into operation. Directors' reports to their shareholders are full of plans for new factories but also of the difficulties met in carrying out these plans.

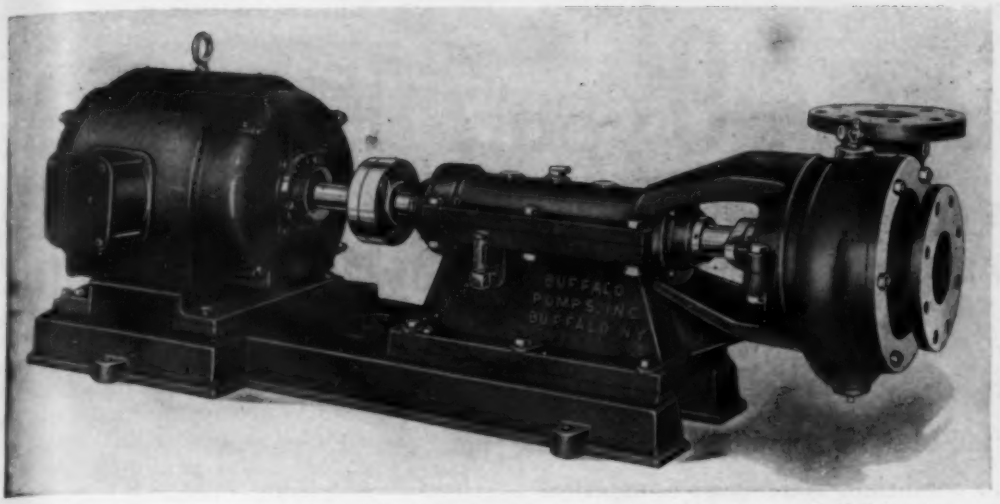
Chemical Imports

Next to essential products in short supply, chemicals for which British industry depends entirely on imports are now receiving special attention. Titanium hydride, sebacic acid, lubricating oil additives, ester waxes, and photographic film base are among new products of relatively limited use for which British manufacturers have developed production plans with the explicit object of replacing imported goods. Some of these new enterprises have been started in cooperation with the U. S. makers who supplied the British market hitherto, so that the new British factories can draw on American processes and experience. The need to economize in the use of imported materials, especially those in world-wide short supply, is also responsible for a considerable amount of research into substitution problems and suitable outlets for previously neglected domestic raw materials. Seaweed, peat, lignite, flax waste, and surplus fish have all been examined in this connection, and some of these materials will be commercially used this year already. Plants for the extraction of alginic acid from seaweed, edible oil and protein from herrings, montan wax from lignite, etc., are under construction or in the initial stage of operation.

Successive Shortages

Not the least difficult of these problems connected with the general shortage of chemical raw materials is that certain shortages when at last overcome were swiftly superseded by others. The paint industry, for instance, which by strenuous efforts succeeded in raising the total production above the prewar level although it receives less linseed oil than before the war, is now faced with a no less difficult problem arising out of the shortage of pigments, solvents and resins. These shortages are primarily due to the necessity of conserving the country's gold reserves and keeping purchases from the dollar area down, but would be less severe if there were surplus plant for additional production available in Britain. This is not the case, and to make matters worse chemical manufacturers in need of additional equipment find that the types of plant and machinery which they require are also in demand for pumping stations, sugar refineries, gasworks and food factories, to say nothing of the in-

CENTRIFUGAL PUMPS FOR EVERY SERVICE



Buffalo Type CS Pumps are available in many alloys and special metals. Full ball bearing.

SPECIFICATIONS *that add up to* BETTER PUMPING

CASING: Solid shell volute type with removable suction side plate. Male and female fit insures perfect alignment of casing with supporting housing. Casing can be revolved before or after leaving the factory to give at least four different positions of openings. Unless otherwise requested, pumps are arranged with vertical up discharge. Can be furnished either rotation.

WEARING RINGS: Easily renewable wearing rings, protect casing from wear.

IMPELLER: High efficiency enclosed type with liberal openings to pass abrasive solids. Enclosed impeller construction eliminates wear on the pump casing. Impeller mounted on shaft by feather key and lock nut and screw. Open impeller can be furnished where necessary, in which case wearing rings are omitted.

BEARING HOUSING: Supporting head and bearing housing cast integral and bored at same operation insuring permanent alignment of all parts. Large oil capacity reservoir requires replenishing at only infrequent intervals. (Size 3 and larger pumps have horizontally split bearing stands, with labyrinth type rotating seal to protect against foreign materials.)

BEARINGS: Oversize ball bearings properly spaced to provide rigid support for shaft with overhung impeller. Outer face of each bearing has built-in labyrinth seal to protect it against entry of foreign material. Bearings run in oil.

SHAFT: Protected from wear by removable shaft sleeve. Shaft is oversize to insure smoothness of operation, minimum packing disturbance and minimum wear.

STUFFING BOX: Extra deep (2" min. for No. 1 pump and progressively increases for larger pumps) — accommodates 8 or more rings of packing.

GLAND: Bolted type — packing furnished Special rotary seals can be supplied.

WATER SEAL: Furnished only when required in special cases. Clear water connections at bottom of stuffing box are provided where necessary to protect against entry of foreign material.

SHAFT FLINGER: Provides additional bearing protection.

SUBBASE: Heavy casting, ribbed and stiffened.

COUPLING: Flexible type.

FITTINGS: Drain plug and air cocks.

TESTS: Each pump tested at factory over entire operating range.

FINISH: Painted, filled and rubbed down outside with final finishing coat. Bright parts exposed to weather protected by slushing compounds.

Pumps like this for YOUR liquids — write for Bulletin 982, describing the entire line.

IN BUFFALO SINGLE STAGE PUMPS

PUMPS by "Buffalo"

For

- WATER ANY TEMPERATURE
- PAPER STOCKS (NON-CLOGGING)
- GENERAL SERVICE
- ACIDS
- ALKALIS
- SLURRY
- CONDENSATE RETURN
- SUMP CLEARANCE
- FIRE SERVICE
- SEWAGE
- SELF-PRIMING SERVICE

BUFFALO PUMPS, INC.

501 BROADWAY BUFFALO, N. Y.

Canada Pumps Ltd., Kitchener, Ont.

RUGGED, PRECISION CONSTRUCTION — FOR LONG LIFE

paint job lasts 9 years

THANKS TO REACTION —
N SILICATE AND HYDROCHLORIC ACID

Nine years of protection for this 225 foot stack, surfaced with a paint of air-floated silica pigment, suspended in a vehicle of stabilized silica sol. Despite weathering, the paint was still in good condition. Here is an economical protective vehicle which is good for brick, stone or concrete; and it's made with N Brand Silicate of Soda reacted with hydrochloric acid.

N Silicate and HCl also react to form gels which may be modified for use as catalysts, desiccants or thermal insulation. A similar gel serves as a binder in a plastic mixture of silica and sodium silicate (N) reacted with HCl to form refractory blocks.

How can silica sols or gels serve you? Let us send you samples of N Silicate, and information for the preparation of the sols.

PHILADELPHIA QUARTZ CO.
Dept. A, 119 South Third St., Phila. 6, Pa.

SILICATES PQ OF SODA

dustries bordering on the chemical trades which show a tendency to erect chemical plants for their own needs.

Efforts to obtain chemical materials in short supply from continental sources have not been very successful. Hopes for larger supplies from Germany have been disappointed, although potash salts will be obtained under special arrangements from the Russian as well as the British occupation zone. Other bulk chemicals are in such short supply in Germany that they cannot be exported. With regard to soda ash the government has studied the question of obtaining material from the Magadi Lake in East Africa. Import statistics for the last year show an appreciable increase over pre-war figures in British purchases of all fertilizer materials (except Chile saltpeter), drugs, tanning extracts, blacks, many pigments, sulphur, and some minerals, but imports of ochres, lithopone, turpentine, magnesite, pyrites, bauxite, gelatine and starches were still below the 1938 level. The decline in purchases abroad of these and other materials of chemical interest was not due to any falling-off in British requirements but entirely to world market conditions and financial considerations. It is the more serious as the stocks of these imported chemical raw materials are now very low. In present conditions, however, the import licensing authorities cannot relax their strict control.

Plan Sulphate Pulp Mill At Vancouver Island

PLANS for a $12,000,000 sulphate pulp mill on the east coast of Vancouver Island, B. C., have been announced by H. R. MacMillan Export Co. This replaces earlier plans for a pulp board mill. Up to 200 tons of bleached sulphate pulp will be produced daily. Only timber waste from company operations will be used as raw material. Construction is expected to start in the near future and to reach completion by early 1950.

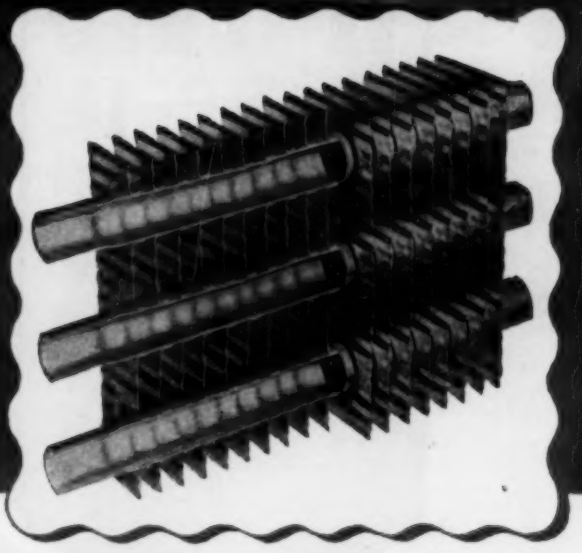
Foreign Briefs

Mysore State, India, is studying plans for establishment of a rayon plant following results of tests made in the United States which indicate the native bamboo forests would offer suitable raw material.

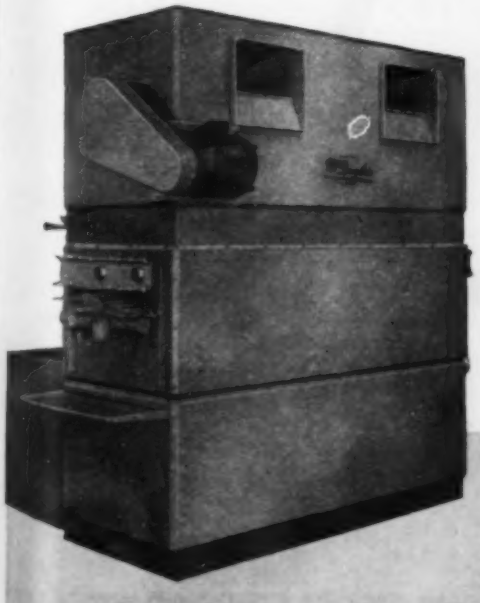
Poland is reported to have an exportable surplus of from 7,000 to 10,000 metric tons of white lead. Production last year was about 13,000 tons which is considerably above the pre-war average.

McQuay year 'round AIR CONDITIONERS

with RIPPLE-FIN coil construction



MAKE THE SEASONS COME TO YOU



Complete flexibility of operation with McQuay air conditioning units, assures the comfort you want. From factory to small shop, McQuay units provide the right degree of fresh, conditioned air necessary for efficient working atmosphere. Secret of McQuay air conditioning performance is the versatile Ripple-Fin coil, with tubes hydraulically expanded into fins for unmatched heat transfer efficiency. Continuous plate-type construction, tough, vibration-free Ripple-Fin coils mean added years of dependable service. McQuay Year 'Round Air Conditioners are available in horizontal or vertical type models in a wide range of capacities for new or remodeling installations. See the McQuay representative in your area, today, or write McQuay, Inc.

McQuay Inc.

1622 Broadway Street N. E. • Minneapolis 13, Minnesota

IN HEATING • AIR CONDITIONING • REFRIGERATION • IT'S THE REAL McQUAY

THEY'RE ACID-PROOF AND ALKALI-PROOF!

"NATIONAL" GRAPHITE BUBBLE CAPS AND TRAYS

A typical installation of "National" bubble caps and trays in a brick-lined tower. Monolithic or fabricated trays are easily adapted to all types of tower construction, including standard "Karbate" towers.

"National" Graphite and "Karbate" Impervious Graphite bubble caps and trays last equally well in towers where either acid or alkaline conditions exist or where these conditions exist alternately. They are widely used in the organic and inorganic chemical fields, in scrubbing, absorption, and distillation towers.

OTHER ADVANTAGES ARE:

1 Easier to install because of the one-piece bubble cap construction.

2 Light weight with adequate strength.

3 Highly resistant to thermal shock.

4 No metallic contamination or plugging of slots by the products of corrosion.

Cutaway section of a "National" bubble cap, illustrating the exceptionally strong one-piece construction.

The terms "National" and "Karbate" are registered trade-marks of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

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30 East 42nd Street, New York 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

These products sold in Canada by Canadian National Carbon Company Limited

FOR MORE INFORMATION ON "NATIONAL" GRAPHITE AND "KARBATE" IMPERVIOUS GRAPHITE BUBBLE CAPS AND TRAYS, WRITE TO NATIONAL CARBON COMPANY, INC., DEPT. CE.

THE CORROSION FORUM

Edmond C. Feller, ASSISTANT EDITOR

Nitric Acid

Part III of a symposium in which construction materials are evaluated for nitric acid services

WORTHITE

E. T. COLLINSWORTH, JR.
Worthington Pump and Mach. Corp.
Harrison, N. J.

EXPERIENCE, as well as laboratory investigation, has demonstrated that Worthite is an unusually satisfactory material for pumps and valves for the transfer of all concentrations and temperatures of nitric acid. This holds true not only in the manufacture of nitric acid, but also in the production of dyes, explosives and other nitration processes.

Generally speaking, all stainless steels of iron and 13 percent or more chromium are resistant to oxidizing media, such as nitric acid. Worthite is of the stainless class but exceeds the standard types in alloy content. It contains 24 percent Ni, 20 Cr, 3 Mo, 3.5 Si, 0.07 max. C, and 2 percent other non-ferrous elements.

The first installation of Worthite pumps in the manufacture of nitric acid was at a large western ordnance works. Here 21 were used with 60 lb. pressure. Using water seals of 80 lb. pressure, nitric acid was handled satisfactorily at all strengths as its concentration was increased from tower to tower, seven towers per unit. In view of the experience obtained from this installation potential trouble with this process can be avoided by specifying pumps with solid shaft construction, eliminating the necessity for a shaft sleeve. Generally speaking, it has been found that with high pressure services trouble can develop when tight packing shuts off the water seal and causes expansion of the shaft sleeve by overheating. This can result in a loosened impeller, scored suction head and sometimes even a shaft breakage.

Specifically, Worthite pumps are used extensively in the successive oxidation and hydration divisions as the nitric oxide is subjected to continuous water cooling in the stainless steel absorption tower. They are also used in drawing off the saturated product. In the division of the process where sulphuric acid is used to concentrate nitric acid from 68 percent to 95-98 percent, Worthite pumps should be economically satisfactory. Numerous users of nitric acid also use Worthite chemical pumps for more normal suction pressures. Nearly every ordnance plant manufacturing explosives during the war used all types of these pumps.

A few of the many industries using Worthite pumps involving nitric acid are outlined below in brief, giving, in order, the product made, services involved, and solutions handled:

Dyes; transfer, mixing, filtering; nitric acid, sulphuric acid, acetic acid, alkaline and acid salts.
Explosives; nitrator, spent acid recovery, sulphuric acid concentration, denitration; nitric acid, sulphuric acid, mixed acid.
Insecticides (arsenates); recovery towers, generators, filter presses, drum dryers; nitric acid, arsenic acid, arsenates.
Nitric acid (ammonia oxidation); carboy filling, storage, transfer; nitric acid (all strengths).
Nitric acid (soda process); hyponitric recovery, towers, storage, concentration; nitric acid (all strengths), mixed acid.
Pharmaceuticals; mixing, filtering, recovery; sulphuric acid, nitric acid, acetic acid, phosphoric acid.
Pigments; transfer, mixing, filtering; nitric acid, sulphuric acid, acetic acid, acid and alkaline salts (some very hot).

NICKEL, NICKEL ALLOYS

W. Z. FRIEND
International Nickel Co.
New York, N. Y.

MONEL, nickel and Ni-Resist alloys are subject to severe attack by nitric acid and usually are not used with this acid except in extremely dilute solutions. The results of laboratory corrosion tests of these materials in nitric acid solutions are shown in Table I.

Inconel, because of its chromium content, is more resistant to nitric acid than any of the above materials. It is particularly resistant to nitric acid concentrations higher than about 20 percent and below about 3 percent at atmospheric temperature. Ordinarily it would not be used at elevated temperatures except in the dilute solutions formed by hydrolysis of some acid nitrate salts. For example, Inconel is used with water solutions of silver nitrate and ammonium nitrate at somewhat elevated temperatures. Inconel commonly is used for baskets and other parts in the pickling of brass parts in cold nitric acid solutions. The results of laboratory corrosion tests of Inconel in nitric acid solutions are shown in Table II.

(Continued. Over)

Table I—Laboratory Tests of Monel, Nickel and Ni-Resist in Nitric Acid

Acid Conc., % HNO_3 by wt.	Temp., deg. F	Duration of Test, hr.	Aeration	Corrosion Rate, Mils per Year		
				Monel	Nickel	Ni-Resist (Type 1)
0.5	95	—	None	24	11	—
5.0	Room	—	—	16	—	826
5.0	Room	13 days	Air-Sat.	66	249	—
5.0	86	—	Air-Sat.	65	—	—
10.0	60	—	—	99	—	2,360
20.0	95	728	—	4,890	1,330	—
25.0	60	—	—	1,100	—	1,030
35.0	86	—	Air-Sat.	2,920	—	—
50.0	60	—	—	10,900	—	1,030
Conc.	60	—	—	—	—	745
Conc.	95	—	—	—	285	—
Red Fuming (13–18% NO_2)	Room	48	—	61,500	—	1,280

Table II—Laboratory Corrosion Tests of Inconel in Nitric Acid Solutions

Acid Conc., % HNO_3 by wt.	Temp. deg. F	Duration of test, hr.	Velocity, ft./min.	Aeration	Corrosion Rate, Mils per Yr.
1.0	194	19	16	—	4
1.0	Boiling	144	—	—	5
5.0	86	24	16	Air-Sat.	6
5.0	86	24	16	H_2-Sat.	66
15.0	86	24	16	Air-Sat.	38
15.0	86	24	16	H_2-Sat.	110
25.0	86	24	16	Air-Sat.	2
25.0	86	24	16	H_2-Sat.	1
35.0	86	24	16	Air-Sat.	2
35.0	86	48	16	None	1
55.0	86	48	16	None	1
65.0	86	24	16	None	3
Red Fuming (13–18 % NO_2)	Room	48	None	None	1

HILCO OIL RECLAIMERS

For Complete Removal of Solids, Moisture and Gases From New and Used Lubricating and Sealing Oils.

- For Vacuum Pumps
- For Absolute Low Pressures
- For Refrigeration Unit Charging Lasting Lubrication

Save Money — Oil — Equipment

Complete HILCO Vacuum Pump Lube and Sealing Oil. Continuous Purifying System Plans Available

Let us show you how to deliver pure oil to refrigeration units with a HILCO charging system.

HILCO Oil Reclaimer Model B-1

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THE HILLIARD CORPORATION
131 W. Fourth St., Elmira, N. Y.

Additional Working Capital

MANY established corporations today need additional working capital to provide for increasing production and distribution costs. Many need funds for expansion or modernization.

During the past twelve months a new economical method of raising capital by means of preemptive rights has been perfected. We have prepared a booklet which describes this new financing technique.

Upon request, we will be pleased to send a copy of our new booklet entitled "The Financing of Stock Issues with Preemptive Rights."

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44 Wall Street New York 5, N. Y.

PROTECTIVE COATINGS

NITRIC acid attacks most organic materials. Concentrated nitric acid is a strongly oxidizing acid and not until recent years have there been found nitric-resistant organic materials for regular use as film-forming agents. The following are resistant to nitric acid: Polyvinyl chloride, the co-joint polymer of polyvinyl chloride, polyvinyl acetate, polyvinyledene chloride, polystyrene, methyl methacrylate, and silicone rubber.

The phenolics, ureas, melamines, cellulosics, acetates, butyrates, etc., can only be used in relatively dilute solutions, or where occasional spills of weak acid are anticipated.

Laboratory tests (see table) of proprietary protective coatings have indicated considerable variations among those that are ordinarily considered acid resistant. All of these protective coatings have been tested by application on ½-in. round bar stock with the end rounded off to a ½-in. radius. Six or seven coats were carefully applied. Even with considerable care on well prepared surfaces, there is considerable variation between the results obtained with the same protective coatings, and these results may be considered as screening tests and are not necessarily indicative of the best performance of these materials.

The author of this article is with a large chemical company which uses, but does not produce, protective coatings.

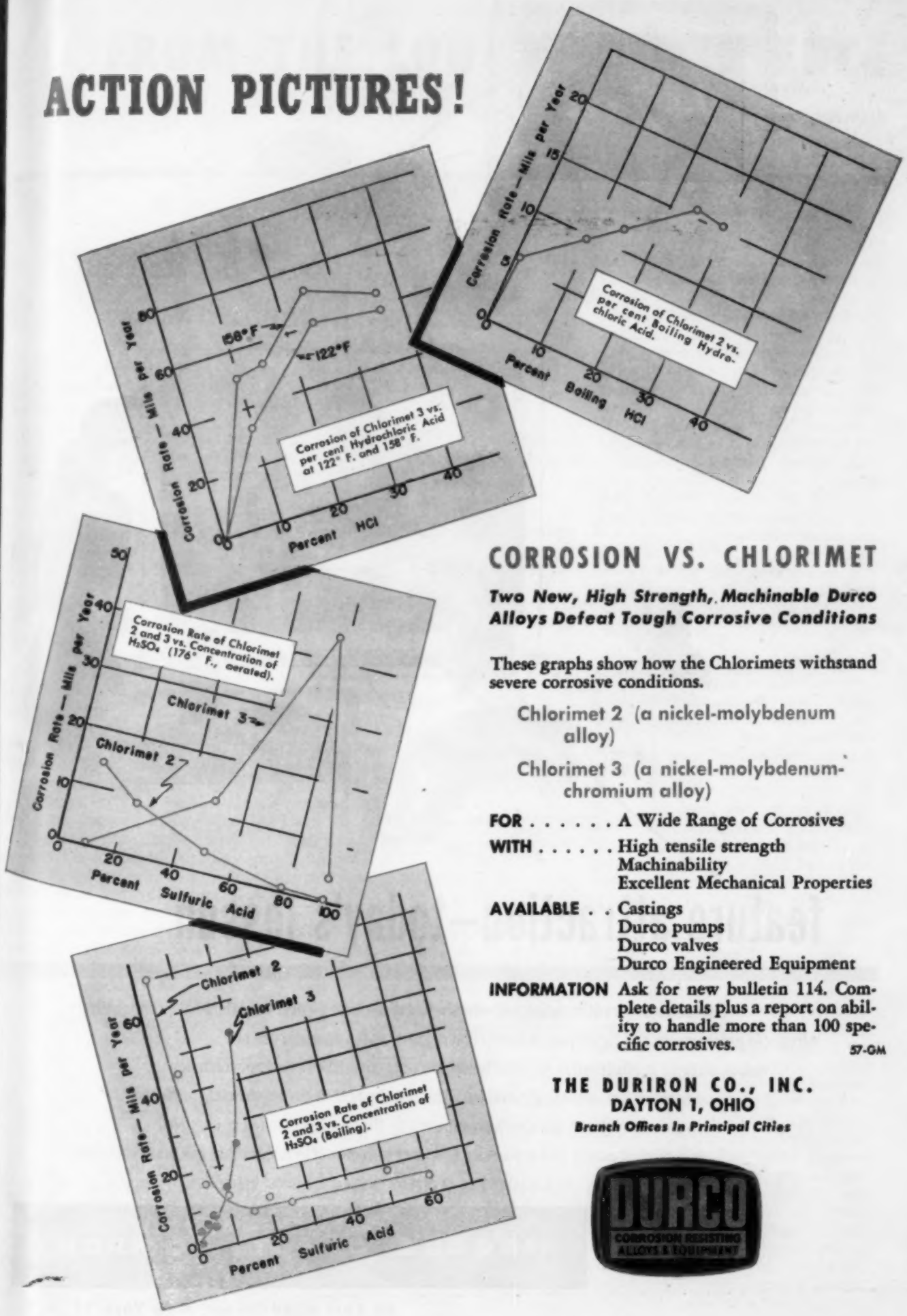
Protection of Steel Panels in 50 percent Nitric Acid at Room Temperature

	Days Protection by Coating
Prufcoat, Prufcoat Laboratories Inc.	14, 13, 7+*
Neolac, Chamberlain Eng. Corp.	14
NuType 150, Gregg Co.	7+*
Corrosite, Baker Synthetics Inc.	14, 7+*, 3, 1
Tygon, U. S. Stoneware	7+*, 1
Cocoon, R. M. Hollingshead Corp:	6
Stayzon, Stayzon Finishes.	4
Neolux, Chamberlain Eng. Corp.	3
Sovaklor, Socony Paint Prods.	2
Nukemite, Nukem Prod- Corp.	2
Koralon, Tycor Prods. Inc.	1
Valdura, American Marietta Co.	1
Rubber Coat, Wilbur and Williams Corp.	1
Fedelco, Federal Electric Co.	1
Penkote, Peninsular Chem. Prod.	1, 1
Kromail, Munroe Sander Corp.	No protection
Sanco, Munroe Sander Corp.	No protection
Garland, Garland Co.	No protection

* Coating was still furnishing protection when test was arbitrarily stopped after seven days.

Where more than one number is given for a particular coating, it means the coating was tested more than once; each number is for a separate test.

ACTION PICTURES!


Corrosion Rate — Mils per Year
158° F
122° F
Corrosion of Chlorimet 3 vs. per cent Hydrochloric Acid at 122° F. and 158° F.
Percent HCl
Corrosion of Chlorimet 2 vs. per cent Boiling Hydrochloric Acid.
Percent Boiling HCl
Corrosion Rate of Chlorimet 2 and 3 vs. Concentration of H_2SO_4 (176° F., aerated).
Chlorimet 3
Chlorimet 2
Percent Sulfuric Acid
Corrosion Rate of Chlorimet 2 and 3 vs. Concentration of H_2SO_4 (Boiling).

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Two New, High Strength, Machinable Durco Alloys Defeat Tough Corrosive Conditions

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Chlorimet 2 (a nickel-molybdenum alloy)

Chlorimet 3 (a nickel-molybdenum-chromium alloy)

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FROM THE LOG OF EXPERIENCE

Dan Gulleben, ENGINEER

The Painful Growth of MSG

Being an account of James E. Larrowe's twelve-year struggle to wring monosodium glutamate out of beet sugar waste. For the latest chapter in MSG's dramatic history, see this month's lead article (page 100) and pictured flowsheet (page 136).

CONSTRUCTION of beet sugar houses was tapering off in 1919 and so Larrowe's construction organization eagerly sought contracts to maintain existence. Under this circumstance James E. Larrowe went to Ogden to interview Banker Pingree to solicit the contract for his proposed Hooper, Utah, factory. Pingree informed him that it was too late. The job had been given to an engineer from San Francisco. When Larrowe heard the name he replied, "Mr. Pingree, you made no mistake. I've been trying to hire that fellow myself but I never had money enough!"

LARROWE'S FIRST CONNECTION with business was an apprenticeship in his father's buckwheat mill in Cohocton, N. Y., established in 1849 as the Larrowe Milling Co. In the course of his development he moved to the metropolis and became a marketer of imports from Europe. Here he came across a chance shipment of dried beet pulp from Germany. In order to move it he informed himself of its merits and then induced a large dairyman to try it free of charge. The effects were wholesome and the dairyman demanded more. Larrowe's feed mill proceeded to develop blending formulas using dried pulp obtained from recently installed German dryers in Michigan beet sugar factories. In order to expedite the installation of dryers so as to expand his business he undertook to make complete installations at the sugar factories at his own expense. He offered a specified price per ton with the stipulation that half of it would be retained by himself until the cost of the dryer had been returned. Thereafter the dryer would become the property of the sugar company. This activity spread from New York to California and his generous contracts and expert marketing facilities brought him profitable business.

THE SUCCESS with dairy feed promoted his urge to spread the benefits of his manufacturing facilities to chickens so as to bring some luxury to these barnyard scavengers and to improve their performance. However, before he could induce the farmers to use the new feed, he had to determine the needs and predilections of both the chickens and the farmers. He established a research project with some "philosophers" from the University of Michigan and dubbed them "chickenologists." They had a ten-syllable word for a certain indisposition that affects chickens fed on unbalanced ration. He replaced the professor's designation with the farmer's and called it "pip" and then proceeded by the device of "farm testing" to learn the chicken's preference and prejudice in the matter of diet.

THE FIRST DRYER DESIGN covered a steam heated apparatus and was acquired by Larrowe in Germany where there was a 25-yr. background of experience. The German constructor interpreted Larrowe's long journey to his works as a measure of the esteem for the machine and accordingly named a price of $50,000 for the American rights even though his patent was soon to expire. Larrowe compromised at $600 per installation. He eventually built nine of these but the direct fired dryer of his own design became the more popular. When the heat was turned on in his first dryer, the furnace collapsed in conformity with the formula by which Providence administers discipline to restrain speed and promote caution in the building of foundations.

WITH THE PLANS from Germany, Larrowe brought an engineer, expert in the art. To emphasize good faith, Larrowe gave him a written contract, and this practice continued periodically long after the engineer had become Americanized. By degrees the engineer's hearing deteriorated. He resisted the use of a hearing aid and thus provided a source of discomfort to Larrowe. On the occasion of the expiration of the old contract, Larrowe prepared two new ones, signed them and sent them to the engineer. The two were exactly alike except that one carried a greater emolument and there was attached to it the stipulation that the party of the first part equip himself with a hearing aid. This is the one that received the engineer's signature.

SUGAR FACTORY CONSTRUCTION was a logical step forward after the dryer construction crews had acquired proficiency. It promised not only to maintain their practice but to improve it. Larrowe instituted the enterprise with a factory at Paulding, Ohio, in 1910 and continued for ten years with profit and renown though not without some drama. The Toledo job, rated at 1,000 tons of beet sugar per day, was started in 1912. When the construction was well advanced, Congress began the debate on the proposition of abolishing the tariff on sugar imports. A great clamor arose for a bill for "free sugar in three years." Gloom spread throughout the industry. The debate inspired panic and the Toledo stockholders reneged on promised stock subscriptions. Unless funds could be raised to complete the factory and process the beets under contract with the farmers, financial disaster would overtake Larrowe. Fortunately Captain James Davidson's name was on the list for $400,000 of bonds. "Young Jim" told Larrowe that in view of the Congressional hostility to beet sugar, the industry was doomed and further investment would be a total loss. Nevertheless, his father's promise was an obligation and he would therefore take up the bonds. For additional funds Larrowe applied to a Toledo bank for a loan of $240,-

MATERIAL HANDLING News

You'll appreciate why Clark Electric Battery-Powered Fork Trucks enjoy an extraordinary leadership when you consider these basic advantages:

1. **Clark manufactures its own major units**
2. **Clark enjoys the benefit of assembly line production**
3. **Clark provides maximum interchangeability of parts**

Among industrial executives who *know operating costs* of electric fork trucks—taking into consideration initial investment, maintenance cost and operating cost—Clark electric fork trucks are preferred by a generous margin.

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Economical assembly saves dollars for customers. Here electrical control gets final inspection.

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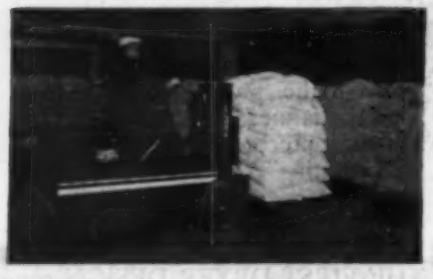

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CLARK GAS AND ELECTRIC POWERED FORK TRUCKS AND INDUSTRIAL TOWING TRACTORS

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REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

000 which was the limit permitted under the bank's capitalization. The trust officer prepared the papers and told Larrowe that he believed in him and was going to urge approval at the board's meeting at noon. However, to fortify himself, he requested Larrowe's opinion of the quality of the loan. The answer was "I think it's a rotten loan but I'll pay it." At the midday meeting every man on the board voted "aye." The Congressional debate concluded with a bill for the abrogation of the tariff on sugar but before the effect of the law could be felt, the war in Europe made sugar a scarce article and the tariff act was repealed.

BEET BYPRODUCTS development under Larrowe's practical discretion had been started with the bulky output of pulp, which required no shirt-losing research. The same money that was paid out for dried pulp came back shortly thereafter for finished feed augmented with a profit. When the administration of the pulp traffic no longer exacted full time, he pushed his exploration of other sugar house products to new frontiers.

STEFFEN PROCESS WASTE water at Larrowe's Mason City, Iowa, factory was boiled, carbonated and filtered for the removal of scale-forming lime salts and then concentrated in a special evaporator. The object was to process this material subsequently for the recovery of potash, imports of which from the low-cost source in Germany had been cut off by the war. Concentration proceeded during the manufacturing campaign and the slurry was stored in large steel tanks built for the purpose. In November the war ended and the market price of potash slumped below the cost of extracting it from the Steffen slurry.

THE HEAVY INVESTMENT in concentrated Steffen filtrate was now worthless. The problem of disposal was complicated by the legal restrictions against stream pollution. Larrowe instructed former construction engineer Ed Crofoot to keep his eye on the tanks. In 1920 Iowa was visited by a severe cold wave that depressed the temperature to 30 below zero. Crofoot noticed a leak in a joint in one of the tanks and, in spite of the cold, the trickle did not solidify. Forthwith he visioned a new industry that could supplant alcohol as anti-freeze for automobile radiators. With his friend, Jack Gardner, he hopped on a train for Detroit to submit to Larrowe a proposition to purchase the slurry. The stuff which had up to this time been an abomination suddenly

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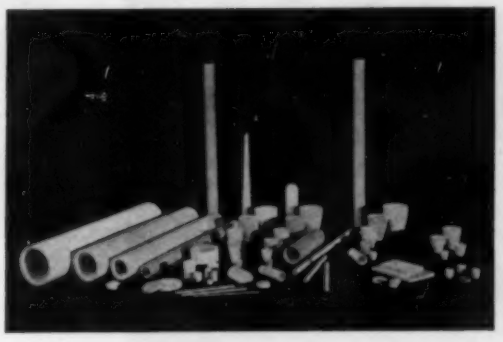

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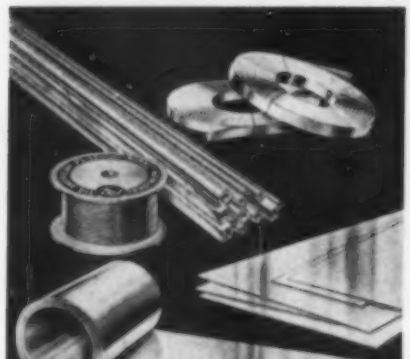

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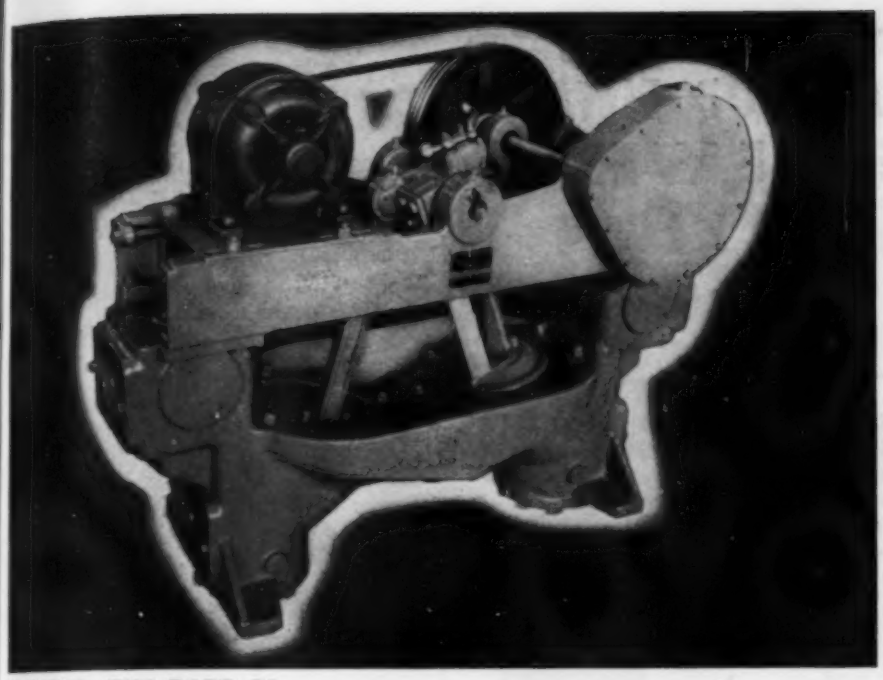
attracted value. Here was a chance to retrieve a part of the loss. When the jockeying concluded, Crofoot and Gardner planked down on Larrowe's desk a check for $10,000 and an agreement to guarantee the balance of $8,000 with a mortgage on some Mason City property.

TO PROPERLY EXPLOIT the discovery, Ed was styled general manager and Jack, sales manager. There was needed a supervisor of the mechanics of packing and shipping. For this job Ed selected John Denny, his former construction assistant. John hesitated about leaving a good job in Salt Lake City for a new activity, the nature of which had not been disclosed. However Ed overcame resistance by wiring him that the new business would put him into the position where he would never again seek a job. The business of advertising and shipping got under way. The boys shipped anti-freeze by the can, drum and carload.

A FEW BARRELS of slurry were shipped to Detroit. Larrowe filled the radiator of his new Packard Twin Six and he and Mowat started out for Toledo for a practical test. After a few miles of driving, the gasket under the valve chest began to leak, the radiator cap blew off and a geyser of hot slurry exploded 50 ft. into the sky. There followed considerable profanity. As progress continued toward Toledo an occasional supplement of fresh water was taken on to tide them over until they could limp into a shop where repairs could be made. In the meantime in Mason City one motorist told another and for about three weeks Crofoot and company were sitting on top of the world. By that time the solids in the new anti-freeze began to plug the radiators. Every day a fresh batch of letters arrived to plague the boys with the threats of lawsuits. Ed in desperation beat it for Detroit to seek advice from Larrowe. There was no remedy except to appease the customers as far as possible. Ed was willing to take his medicine but nevertheless Larrowe returned the $10,000 check and the mortgage.

THE UNUSUAL CIRCUMSTANCE of this experience is the fact that in Ed's radiator the anti-freeze produced satisfactory results. He used it for three months, keeping it at standard density by frequent addition of water. Its perniciousness lay in its appetite for gaskets in old or loosely made joints, which thus permitted leaks into the engine cylinders during idle periods. It also loosened



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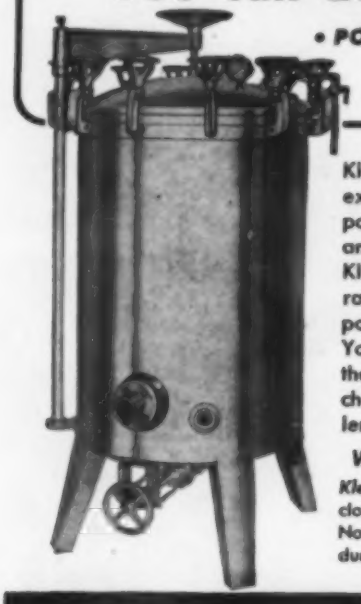

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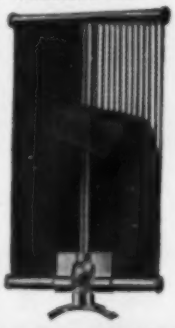

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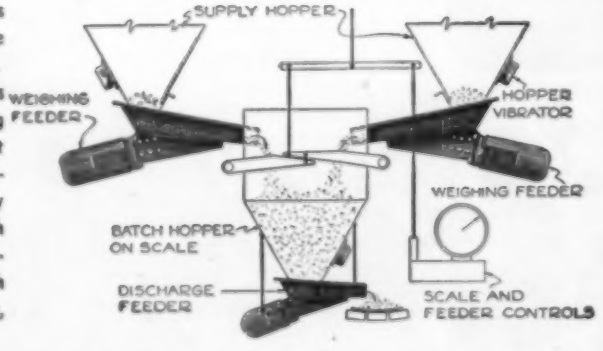

Any one, or a combination of any number of materials may be batched, accurately and automatically, at the same time.

Write us about your problem.

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scale on the interior surfaces of the radiator and thereby uncovered weak spots for leaks. Without notice the fluid supply in the cooling system ran low and overheating took place. John set up a pump to deliver the contents of the returning containers into storage tanks. He said he never saw so many barrels in his life.

THE PROBLEM was now back in Larrowe's lap. Accordingly he shipped the balance of his sample of slurry to the University of Michigan for analysis. The chemist reported a gold mine. Larrowe then arranged with the Mellon Institute for a fellowship to search out a means of recovering useful elements. The thing that aroused the investigators greatest interest was the compound which they dubbed

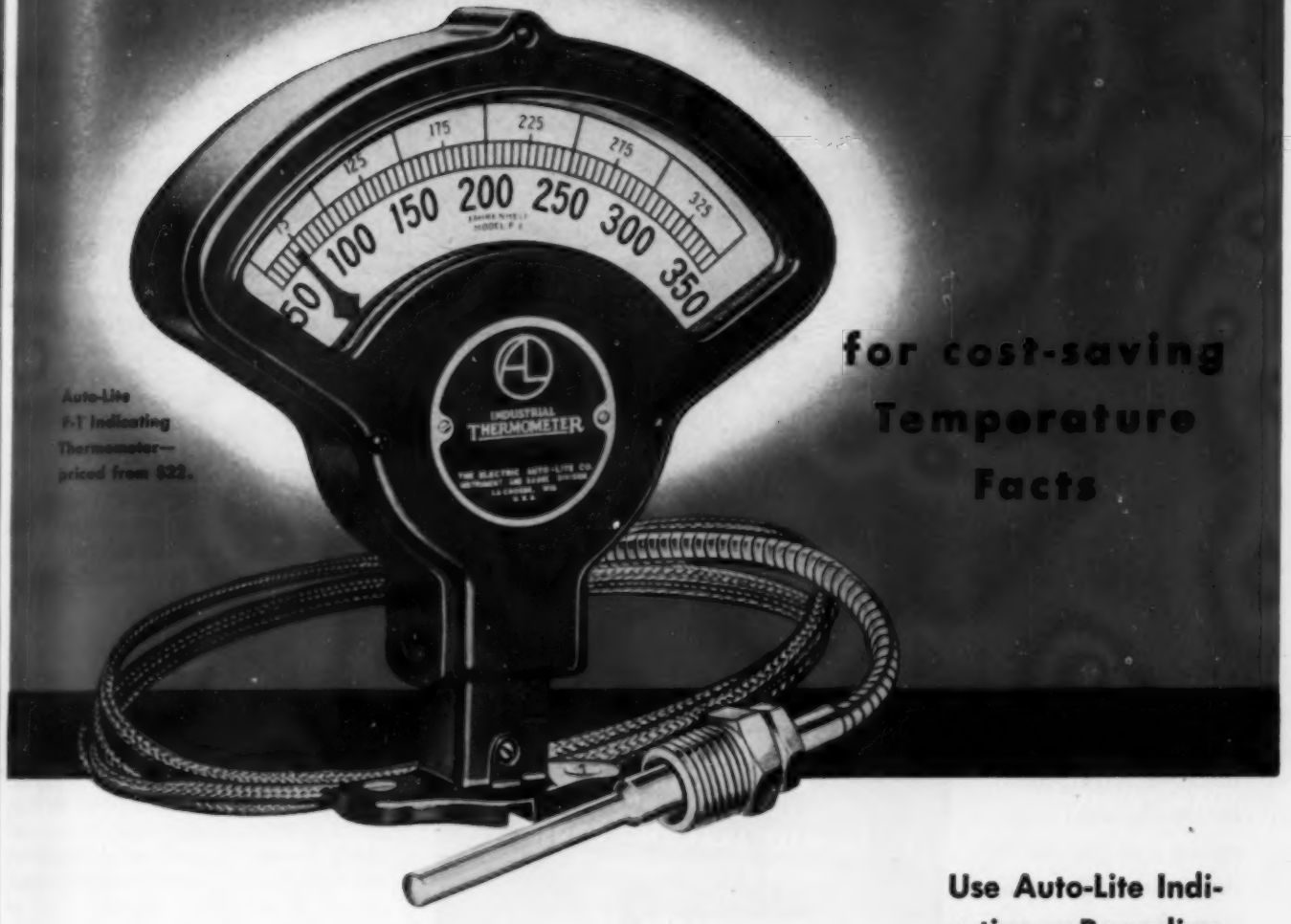
MONOSODIUM GLUTAMATE

This material, MSG, was a chemical curiosity since its first isolation by a German chemist in 1886. However, in 1908 Professor Kikunae Ikeda of the University of Japan discovered its flavor accenting possibilities and called it "ajinomoto" ("the essence of taste"). He extracted it as a white salt and found it just perceptible to the taste when one part of it was dissolved in 3,000 parts of water. By way of comparison, the threshold of taste for sugar is 1:200 and for salt 1:400. MSG is present in fish and other meat proteins as well as in wheat gluten and molasses. Ikeda found it in the seaweed of the south Pacific. It is especially attractive to Orientals to impart a meaty flavor to their vegetable diet and its extraction from a vegetable source makes it acceptable to the Budhists and conscientious vegetarians. According to Larrowe's definition "it makes a stale egg taste better than a fresh one." Medicinally it is one of the 27 varieties of amino acids which experts have recently found to be essential to robust health.

IKEDA DEVISED A PROCESS that was commercially practicable and turned it over to a chemical manufacturer, S. Suzuki, for exploitation. By 1927 Suzuki had developed a market and was producing annually about 5,000,000 lb. The published report of the Mellon Institute's findings came to the notice of Suzuki while he was sojourning in Germany investigating processes for extracting MSG from wheat gluten. He became alarmed lest competition from Detroit, developed from a worthless waste, might impair his monopoly in Japan.

MEANWHILE a process design was evolved in the test tube stage by the

DEPEND ON AUTO-LITE



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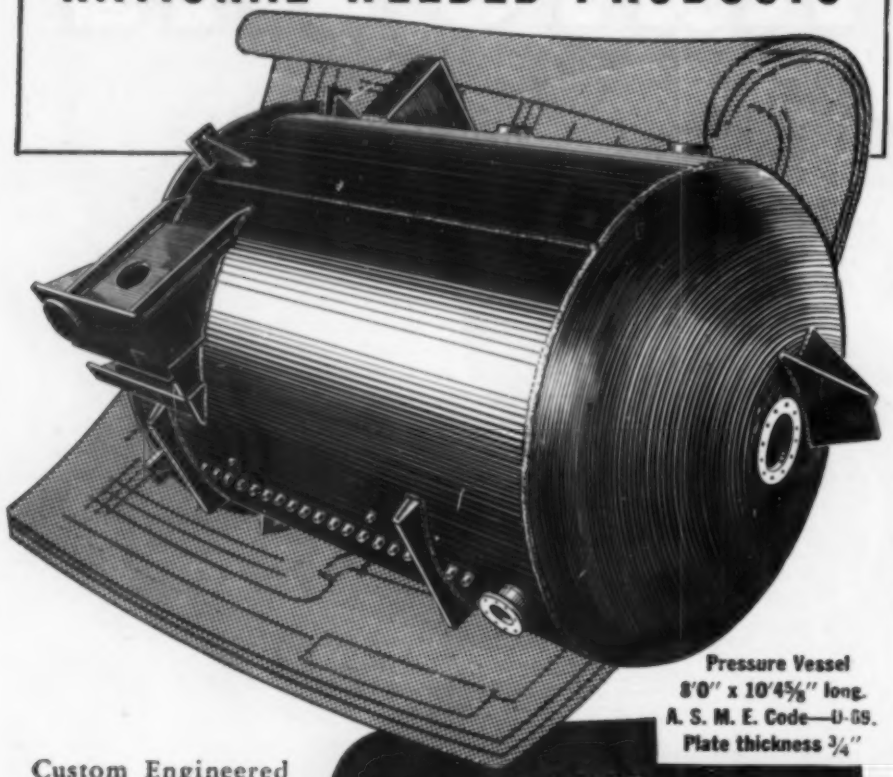

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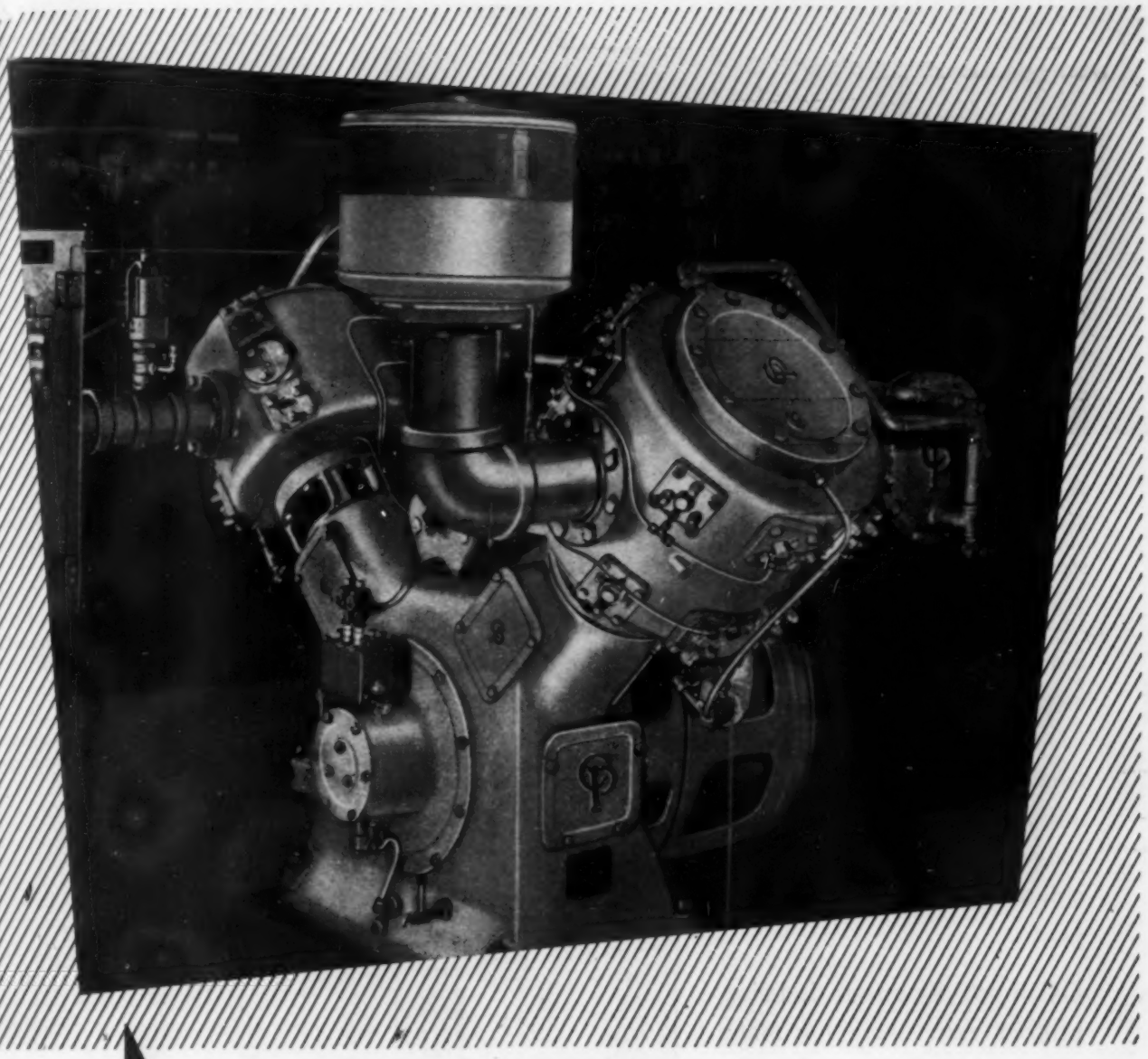
API-ASME Codes • Stress Relieving • X-ray
Pledged to Quality Since 1895
WASHINGTON, PENNA.

investigators at the Mellon Institute. The next step, they insisted, was pilot plant trial to determine the mechanics of duplicating the test tube results. However Larrowe could not abide the delay. He declared that all the steps of the process had been proved in the laboratory, so why wait? Forthwith he organized a staff of engineers and chemists to extrapolate a factory design from the test tube data. Directly they arrived at a cold estimate of $300,000, he ordered the work to begin.

While Larrowe was contemplating his next move, Suzuki proceeded to New York and invited a conference. Larrowe at first abruptly declined. However, Searle Mowat, chief of Larrowe's staff, argued that a dollar is a dollar even if it comes from Oriental traffic and besides Suzuki had the market. Eventually an agreement was reached to grant the Japanese a 40 percent interest and forthwith Suzuki presented a check for $120,000. The agreement stipulated that only glutamic acid was to be made by the newly organized Larrowe-Suzuki Co. of Detroit, and the entire output was to be shipped to Suzuki's plant for compounding into ajinomoto.

THE FACTORY was constructed on Larrowe's property at Rossford, suburb of Toledo, near the site of his feed mill and sugar factory. Troubles began at once. The process which required hydrochloric acid for hydrolizing was so destructive of equipment as to raise the cost of maintenance and plant outage beyond what Larrowe's contract price, as developed by Suzuki, could bear. The monthly output could not get above 4,000 lb. Suzuki sent Ikeda to Rossford but he could pull nothing out of the hat. There was a suspicion that the Japanese preferred failure in America rather than a threat to their monopoly in Japan. Stubbornly Larrowe continued to grope for a solution, making frequent withdrawals from his personal account. Cooperation from Suzuki petered out. He said he had exceeded his authority in committing his associates originally and he could do nothing further. The operation was a complete failure. Nevertheless, Larrowe persisted.

FINALLY IN 1926 Larrowe decided to seek a life preserver in the way of a chemical engineer. Fortunately the selection fell upon Albert E. Marshall of New York (now president of Rumford Chemical Co.). Marshall incidentally possessed the complementary advantage of frank expression of his mind that matched Larrowe's both in picturesqueness and, when the occasion demanded, in sulphurous content



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A manufacturer requiring good limestone has only to look at Oklahoma - - and he will find what he needs. For limestones are widely distributed over the entire state.

In the Arbuckle Mountains, limestone deposits have a combined thickness of about 8,000 feet (if the dolomites are included). Physically, Oklahoma limestones range from friable or chalky to stone with maximum crushing strength; from coarsely crystalline to very fine-grained; and from minutely oolitic to coarsely pisolitic. Chemically, they range from impure stone suitable for woolrock to chemical grade.

Oklahoma limestone is being utilized extensively for many purposes. Its quality and availability merit consideration for a multitude of additional uses.

TYPICAL ANALYSIS
(26 feet)

	Percent
CaO	54.760
MgO	0.680
SiO_2	0.143
Fe_2O_3	0.074
Al_2O_3	0.174
P_2O_5	0.007
SO_3	0.008
Ignition loss	43.940
Total	99.786

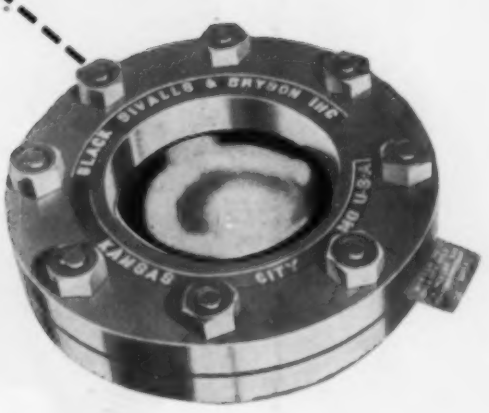
Detailed information on Oklahoma's mineral resources is available on request, based on data by the Oklahoma Geological Survey. Map showing location of mineral deposits is also available.

Larrowe asked him if it could be done. It was necessary to evolve a completely new process. Larrowe's commercial viewpoint demanded a contingent basis of defraying the cost of development, which he subsequently modified under his fine quality of sportsmanship. After nine months of application and many discussions between Larrowe and Marshall, wherein their language met even if their minds did not, Marshall began to see daylight. Two years additional were required for pilot plant development of the process. The Japanese agreement was now a millstone on Larrowe's neck. Both Marshall and Mowat counseled release through bankruptcy, but Larrowe held out until he had three quarters of a million in the project and further progress was stymied by the Suzuki agreement. Bankruptcy proceedings therefore got under way with Larrowe and the agent of Suzuki present in the courtroom. Larrowe's bidding soon exceeded the limit that Suzuki had set for his agent. The court accepted Larrowe's bid of $5,000 and refused the agent's request for delay. Thus the deck was cleared and the plant was revised to fit Marshall's new process. After an experience of twelve years of heartbreaking effort and receivership, and the expenditure of three quarters of a million in cash, Larrowe achieved success.

ONE MORE FLY launched into the ointment. By Suzuki's request a young Japanese chemistry student from the University of Michigan was added to the chemical staff at Rossford. This young man from time to time sent progress reports to Suzuki, which formed the basis of a Japanese patent application. Two years of legal wrangling were required in Japan to establish the priority of Marshall's inventions over Suzuki's.

THE RAW MATERIAL, as stated above, comes from the beet sugar factories which are equipped with the Steffen separation process. The waste water (filtrate) contains most of the residue of the end product molasses after the sugar has been separated. This filtrate is carbonated with CO_2 drawn from the boiler house stack and then boiled and filtered for the removal of lime salts. The liquid thus clarified is concentrated from 4 percent solids to 65 (1.3 sp.gr.) and this concentrated Steffen filtrate is the material with which the glutamic acid starts. The concentrate originally collected at Mason City for the potash production was stored for twelve years before commercial processing began at Rossford for glutamic acid. (Over)

Close Tolerance



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high ratios ?

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This double reduction De Laval Worm Gear Speed Reducer is available in many standard ratio combinations, with horizontal or vertical output shafts and is but one of 93 sizes and types of standard De Laval Worm Gear Speed Reducers.

WG-14

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CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

THE AMERICAN MARKET development paralleled technological progress. By the time the second World War came the demand from soup manufacturers and others became so great as to require rationed deliveries. By 1942 the manufacturing operations cleared a profit of about 10 percent on the total cost of the development of the plant to date. The actual investment, however, as recognized by the U. S. Department of Internal Revenue, excluded expenditures made prior to the receiver's sale. Most of the earnings had been plowed back but the government classed the earnings as a windfall and took 93 percent into the war chest.

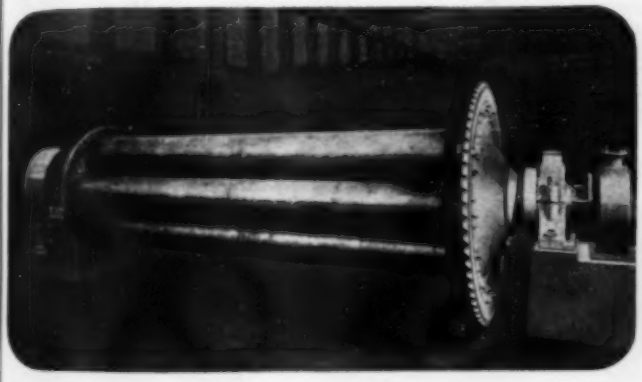
AT THIS STAGE Larrowe developed a desire to "put his house in order" and reduce his burdens so that he could devote himself entirely to his sugar interests. He found a willing purchaser in the International Minerals and Chemical Corp. of Chicago. This organization was heavily interested in chemurgical processes and sought to extend its operations. It was well equipped with a technological staff and the new process fitted well with its current program. The amino products plant of Rossford was therefore transferred to the new owners. The profit in cash was not spectacular but the profit in accomplishment was great. The task of further development was thereafter placed in the hands of Dr. Paul D. V. Manning, research director of the company. Manufacturing and plant extension became the duty of Ralph W. Shafor, well known as a sugar technologist, formerly with Great Western Sugar Co., and as a process developer with the Dorr Co. For good measure Albert E. Marshall was retained for advice and counsel.

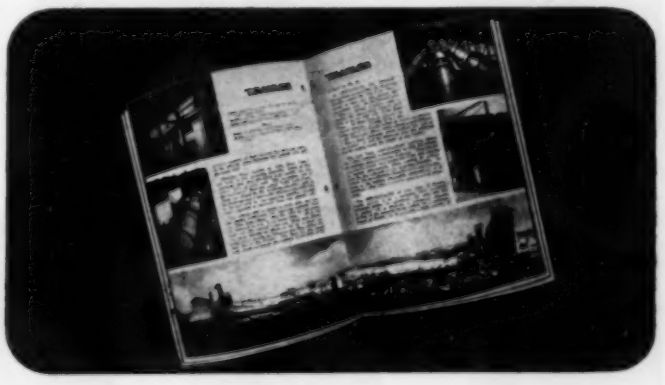
BY 1947 the industry which issued from Larrowe's distressing experience at Mason City, Iowa, had established a great new plant at San Jose, Calif., to supplement the output of the Rossford Plant. Within the same grounds a pilot development plant was built wherein Shafor's staff develops the test tube research of the laboratory in Chicago into commercial processes. At the same time the company proceeded to build concentrating plants at various beet sugar factories in California, together with a tank farm at San Jose. Thus a solution was found for the problem of the disposal of a difficult waste and at the same time it provided relief from the more costly source of wheat for which the war ravaged countries of Europe were clamoring.

40 Years Experience Goes a Long Way Toward Assuring Profitable Kiln Operation

For over forty years Traylor has been building Rotary Kilns. *Every one was designed for a specific operation.* The refinements to be found in every Traylor Kiln are based on that bedrock of experience. More efficient, low-cost production of a higher quality product is the result.

Traylor Kilns have rigid shells of heavy steel plates . . . electrically welded into a single piece! All circumferential joints are reinforced by steel bands into which the welding penetrates. The discharge end is similarly strengthened with a heavy steel band. Riding rings are accurately turned and faced. Steel gears and pinions are precision cut. Improved supports of the most suitable type for each installation are selected from the many advanced Traylor designs.





Traylor Rotary Coolers share all of the structural advantages of Traylor Kilns. They are built in four types. Each is "tailor-made" for the most efficient cooling of your material by air, water or a combination of both. You can select from single or multiple tube types . . . direct or indirect fired.

Traylor equipment is profit building equipment! Write today for illustrated Bulletin 115 which describes Traylor Rotary Kilns, Coolers and Dryers.

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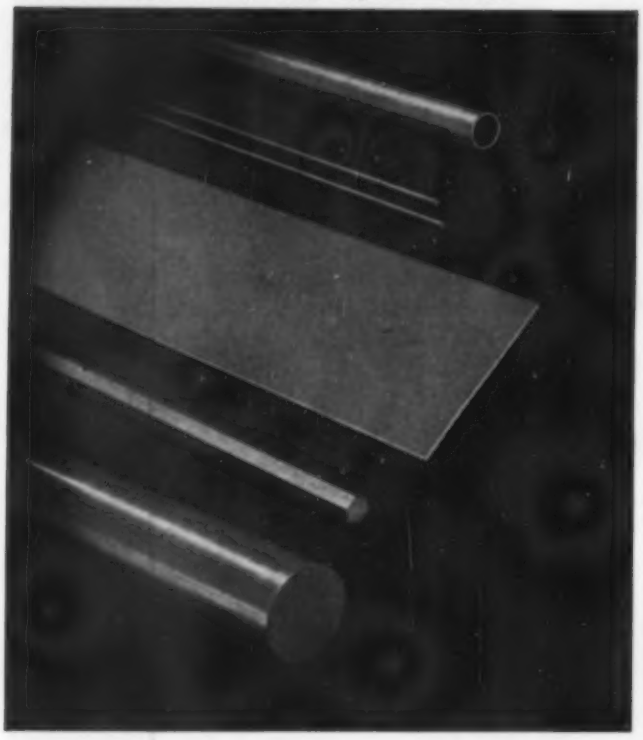
TRAYLOR *Rotary Kilns, Coolers & Dryers*

NEW *Carpenter* Stainless No. 20 to Resist Sulphuric Acid!

Now a New Stainless Steel Ready to Take on New Jobs

Carpenter Stainless No. 20 is available in the forms of bar stock, wire, strip and tubing.



Here is news about a highly corrosion-resistant alloy available for the first time in the forms of bars, wire, strip and tubing.

In the past, the alloy has been available only in the cast form, known as Durimet 20. Now that Carpenter has overcome the problem of producing this alloy in the wrought form, its usefulness in solving corrosion control problems has been greatly increased.

There are two general types of applications in which Carpenter Stainless No. 20 can provide new and increased economy. First, in processes where sulphuric acid solutions are present at various temperatures and in various concentrations. And second, in handling other highly corrosive acids and solutions where an extra margin of safety is required, over and above the corrosion resistance provided by other types of Stainless Steel.

If you care to investigate the corrosion resistance of the material under actual operating conditions, we will be glad to work with you on sample orders.

Corrosion Resistance and Physical Properties Data . . .

These data pages will give you useful information on Carpenter Stainless No. 20 and the jobs it can do. For your copy, just drop us a note on your company letterhead, indicating your title, and ask for the Carpenter Stainless No. 20 data pages. We will be glad to put them in the mail for you.

THE CARPENTER STEEL COMPANY, 127 W. Bern St., Reading, Pa.

Typical Uses for Carpenter Stainless No. 20

Carpenter

STAINLESS NO. 20

LICENSED UNDER PATENTS OF THE DURIRON CO., INC.

Carpenter Stainless No. 20 Tubing and pipe sizes produced by Alloy Tube Division, The Carpenter Steel Co., Union, New Jersey

NAMES IN THE NEWS

Man of the Month

A. H. White

Two dates this month are of special significance to the profession of chemical engineering and to the University of Michigan. First will be the celebration of the fiftieth anniversary of the founding of the U. of M. department of chemical engineering—April 22. Second will be tribute to the seventy-fifth birthday of the department's venerated A. H. White—April 29. *Chem. & Met.* congratulates the department.

We join with the school, its faculty, students and alumni in tendering congratulations and best wishes to Professor White.

Alfred Holmes White was born in Illinois in 1873. He received his A.B. degree 20 years later from the school he was to serve so long. Like all young men bent on studying chemistry in those days, he had to go to Europe for the best instruction. After a year at Zurich, he returned to Michigan to teach chemical technology and work for his B.S. (Ch.E.) degree. (Like some students today, he acquired a wife and lifetime partner before the degree.) With the exception of leave for military service as a lieutenant-colonel in World War I, he has worked for and served the university ever since. Through his efforts and those of other leaders in the profession, it is no longer necessary or desirable to do what Dr. White did—go abroad for chemical and engineering training. America is now the leader.

He is a member of AGA, ASTM, and ACS as well as a member and former president of ASEE and AIChE. Your birthday congratulations may be sent to 608 Onondaga St., Ann Arbor, Mich.

John H. Kelly, Jr., has resigned as research director of the mechanical goods division, the General Tire and Rubber Co., Wabash, Ind. He has been selected to manage and direct three new local concerns which will deal with metal and plastic processes and applications.

Warren F. Busse, formerly director of research for General Aniline and Film Corp., Easton, Pa., has been appointed technical director of the Institute of Textile Technology, Charlottesville, Va.

Frederick O. Dutton has been elected vice-president in charge of production for Process Engineering Inc., Somerville, Mass. Mr. Dutton was formerly with Union Carbide & Carbon Corp.

Robert V. Mellefont of Washington, D. C., has been elected treasurer of the American Chemical Society, succeeding **Robert T. Baldwin** of New York, who retired recently.

Sidney S. Lawrence, for 18 years sales manager of Shell Chemical Corp., has retired.

H. G. Burks, Jr.

H. W. Fisher

H. G. Burks, Jr., a director of Esso Standard Oil Co., has been appointed general manager of the company's manufacturing operations. **H. W. Fisher,** also a director, was named to succeed Dr. Burks as general manager of East Coast refineries.

William A. Bittenbender has been appointed assistant director of the technical development department of Merck & Co., Inc., Rahway, N. J.

Lawrence E. Stout, head of the department of chemical engineering at Washington University (St. Louis, Mo.) has been appointed dean of the school of engineering to succeed **Alexander S. Langsdorf** at the time of the latter's retirement on July 1.

L. E. Stout

P. V. Horton

Paul V. Horton has joined the engineering electronics section of the National Bureau of Standards where he will be concerned principally with the development and utilization of new and improved plastics and other nonmetallic materials.

E. J. McMahon, production manager of the Dearborn Chemical Co., Chicago, has been elected a director and vice president. He succeeds **John W. Brashears** who has been with Dearborn 52 years and who was retired as an honorary director for life.

Charles Allen Thomas, executive vice-president and technical director of Monsanto Chemical Co., will receive the gold medal of the American Institute of Chemists on May 7.

Robert E. Burks, Jr., has joined the staff of Southern Research Institute, Birmingham, Ala., for work in the field of organic chemistry.

Edwin J. Cohn of the Harvard Medical School has been awarded the 1948 Theodore William Richards Medal of the Northeastern Section of the American Chemical Society. The medal will be presented to Dr. Cohn, who is

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Cut shows a 1 HP Eppenbach Homo-Mixer processing entire contents of open-end 55 gallon drum at 7,000 RPM without vibration or splashing.

Mixing tank requires no cover because this mixer will not produce a vortex or other excessive turbulence on the surface.

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The Eppenbach Homo-Mixer is unlike any known batch mixing device. The design permits far higher speeds than are practicable with any propeller or blade-type agitator. Proportional increase in hourly capacity may be easily attained, together with qualitative improvement of resulting mixture.

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Eppenbach

chairman of the department of physical chemistry in the Harvard Medical School, at a meeting at M.I.T. on May 13.

U. E. Bowes, formerly director of research for Owens-Illinois Glass Co., is now president of American Structural Products Co., a recently formed subsidiary company. Other officers include **W. M. Bergin,** vice president, production manager; **T. W. Collins,** vice president, factories manager; **H. W. Paul,** vice president, manager of sales; **E. C. Shuman,** director of research. All have been with Owens-Illinois for a number of years. Headquarters of the company are in Toledo.

Paul D. V. Manning, vice president in charge of research for International Minerals & Chemical Corp., has been elected to a fellowship in the New York Academy of Sciences.

Forrest O. Calhoon has been appointed to the new position of assistant to the president of the Disco Co., Pittsburgh. He comes to Disco from the Varcum Chemical Corp., Niagara Falls, N. Y., where he was plant manager.

G. A. Griess

H. L. Schaefer

Gerald A. Griess has been advanced to the position of laboratory research director of the styrene polymerization laboratory and **Hugo L. Schaefer, Jr.,** has been named laboratory research director of the saran development laboratory of the Dow Chemical Co., Midland, Mich.

Frederic Arden, formerly of WPB and CPA chemical division, has been named to head the new chemicals and drugs section in the Office of Domestic Commerce. **C. C. Concannon** is heading the chemicals branch of the Office of International Trade.

Ralph L. Dodge has been named by the du Pont company to head a newly organized planning division in the ammonia department. The new division will carry out long-range departmental planning and coordination. Dr. Dodge, who was control manager of the department, will be succeeded in that post by **Charles R. Schwartz,** who has

Smilin' Tex says:

"IT AIN'T BRAGGIN' IF YOU CAN PROVE IT"

It's true: In Texas roses bloom in January.

The equable climate on the Texas Gulf Coast is fine for work and fine for play. And the mild winters can be translated into dollars and cents. It costs less to heat homes and factories, the friendly outdoors puts a bloom in children's cheeks, contentment in the minds of the worker.

A hospitable climate is but one reason why you should build your chemical plant on the Texas Gulf Coast. Raw resources of every kind are at hand, refineries manufacture a variety of hydrocarbons in superabundance. there is an expanding industrial market.

Plus: rail, water, highway and air transportation to all markets, domestic and foreign; intelligent, cooperative labor; an abundance of pure water; Texas has a community property law but no state income tax, no sales tax.

Send for a survey. On request, we will prepare for your company a carefully engineered and confidential survey of the Texas Coast Country individualized to fit your particular needs. No cost, no obligation. Address Research Department, Houston Pipe Line Company, Houston, Texas.

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Wellman-Galusha Clean Gas Generators

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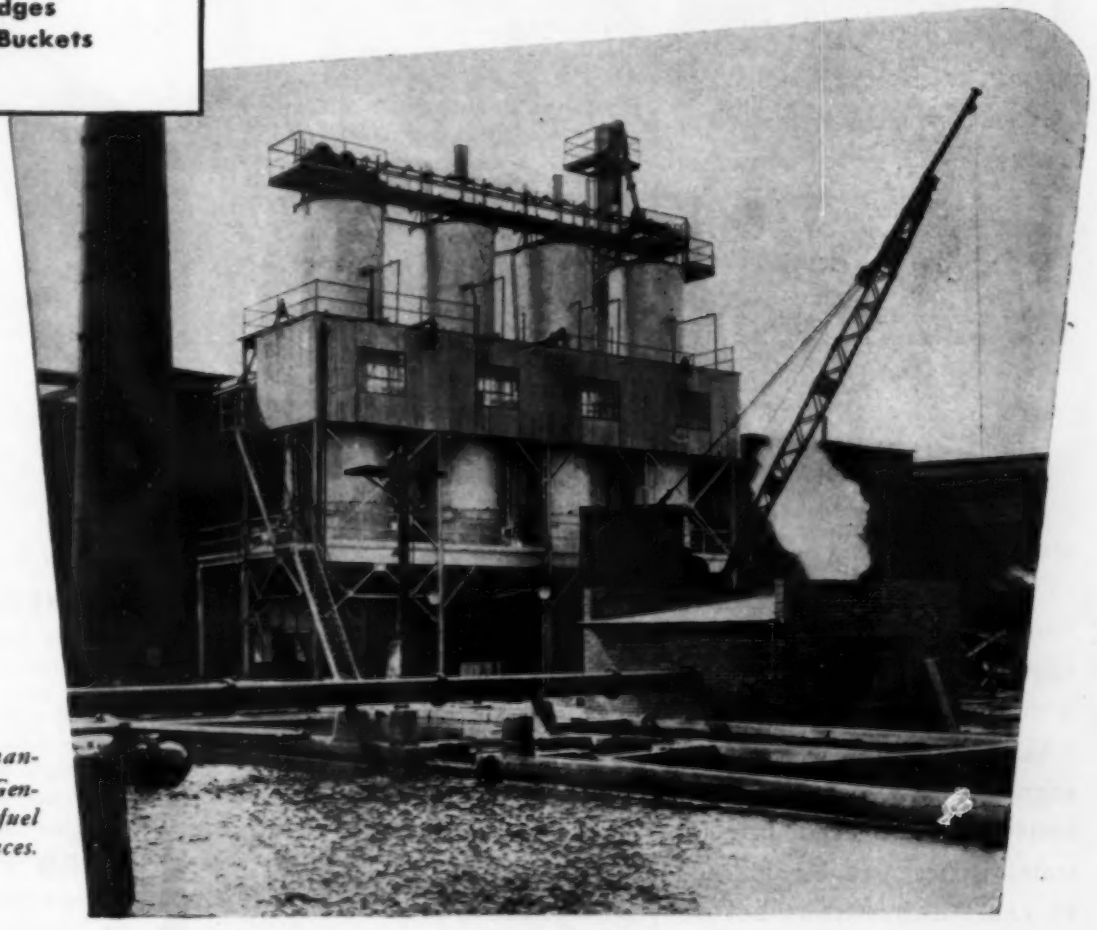

Four 10 ft. Wellman-Galusha Clean Gas Generators supplying fuel for steel mill furnaces.

• Only Wellman builds the Galusha Clean Gas Generators that so ideally meet your requirements with efficiency and economy. These generators combine, in a *complete* machine, the rotary grates, ample fuel storage bin, and provisions for generating the steam required for making the gas. Even the lowest-priced grades of Anthracite and coke can be satisfactorily gasified.

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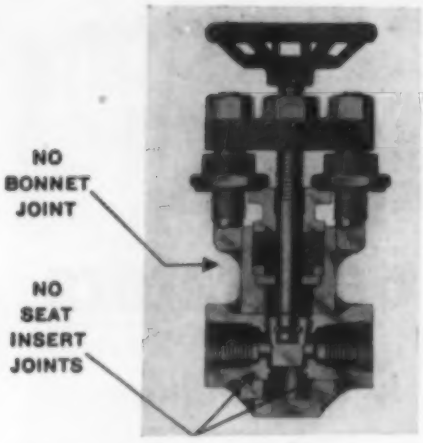

Three joints less!

EACH of these three joints in the conventional gate valve design is a potential source of leakage. *There are no joints in the* Hancock WELDVALVE!

There is no bonnet joint in the Hancock WELDVALVE, because it has no bonnet.

There are no seat insert joints, because the super-hard cobalt-chromium faced seats are integral with the valve body and never need to be replaced. Excess handwheel pressure to align distorted seating surfaces is not necessary for WELDVALVE tightness, because the alignment of the angle of the seats with the "500 Brinell" stainless steel wedge is finished to *exact* dimensions before assembly.

Designed for 800# at 750° F or 2000# at 100° F. Sizes ¼" to 2" inclusive.

Stocked and sold by leading Distributors everywhere. Write them or us for details.

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Makers of Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves and 'American' Industrial Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

been assistant control manager. **Allen E. Lawrence** succeeds Mr. Schwartz.

David N. Hauseman, Brig. General, U. S. Army retired, has been elected president of Houdry Process Corp., Philadelphia, to succeed **Eugene J. Houdry,** founder, who has retired. General Hauseman also will be chairman of the board of Catalytic Construction Co., a Houdry subsidiary.

Robert S. Aries, consulting chemical engineer and director of the Northeastern Wood Utilization Council and adjunct professor of chemical engineering at the Polytechnic Institute of Brooklyn, has formed a new type of engineering office in Brooklyn. The organization, to be known as R. S. Aries & Associates, Consulting Engineers and Economists, is designed to eliminate lag between technological advances and the marketing of new products.

R. S. Aries

C. F. Prutton

Carl F. Prutton, head of the department of chemistry and chemical engineering at Case Institute of Technology since 1936, will resign at the end of the present school year. Dr. Prutton will leave Case to enter private consulting practice in Cleveland.

Elliott R. Weyer, formerly with the Research Corp., has joined the scientific staff of Chas. Pfizer & Co., Inc.

R. D. Hanley, manager of the natural gas department, Magnolia Petroleum Co., Dallas, has been elected to the board of directors of the company. Hanley, a chemical engineering graduate from Texas A. & M. College, joined Magnolia Gas Co. in 1925 and five years later was transferred to Magnolia Petroleum Co. as chief chemist of the natural gas department.

Kirby K. Wyatt has been named chief of the engineering construction branch, division of engineering, U. S. Atomic Energy Commission.

William F. Ryan has been named engineering manager of the Stone & Webster Engineering Corp., Boston, following the death of **August C. Klein. Harry S. Houghton,** formerly

MONARCH CORROSION RESISTANT NOZZLES

Of

Fig. F-80

STAINLESS STEEL:

Available in capacities from .57 G.P.H. Fig. F-80 style illustrated, to 104 G.P.M. (Fig. B-8-A style).

"Hollow" cone, "Solid" cone, and "Flat" sprays furnished in pipe sizes and capacities to suit practically any problem where corrosive liquids are sprayed.

STONEWARE:

Monarch Fig. 6020 and Fig. 6040 stoneware sprays have replaced most other types of nozzles used in acid chamber plants throughout the world. Last almost indefinitely in sulfur gases and will not break or crack from temperature changes.

HARD RUBBER:

Patented Fig. B-27 nozzle is of the "non-clog" type, i.e. it contains no internal vanes, slots, or deflectors which might facilitate clogging. Available ¼" to 1" pipe. Small sizes produce a very fine, soft, wide angle hollow cone spray, even at low pressures.

Fig. H-407 "flat" spray produces a relatively fine even sheet of liquid.

Write for Catalogs 6A and 6C

MONARCH MFG. WKS, INC.
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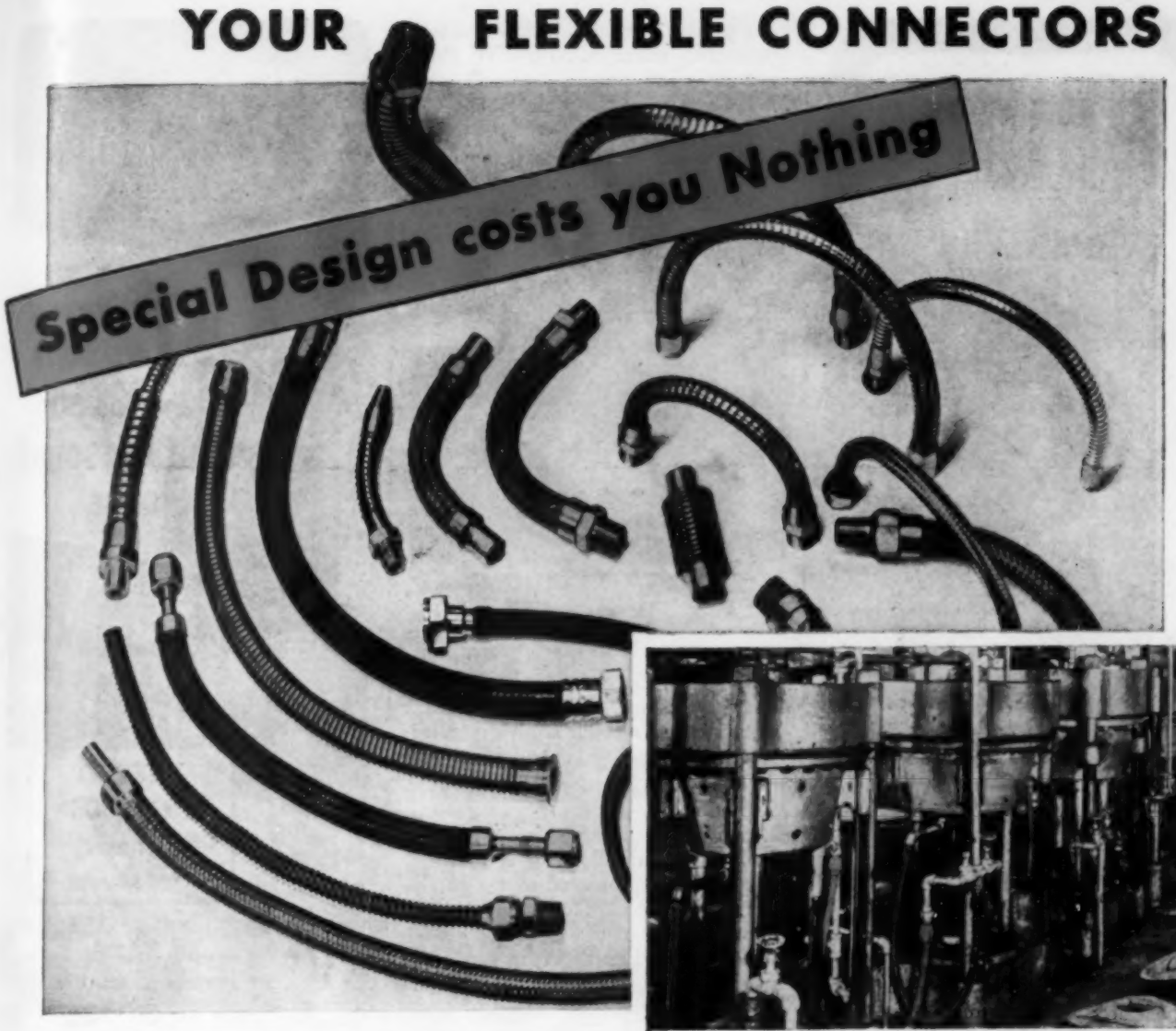
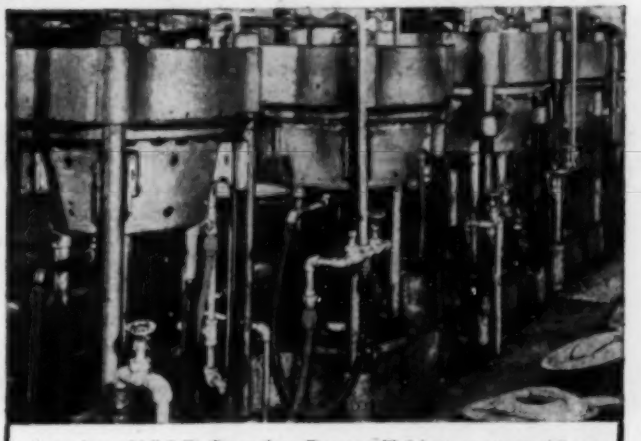
YOUR FLEXIBLE CONNECTORS





American ½" I.D. Seamless Bronze Tubing, protected by a layer of bronze wire braid, carries steam to heat these hat-forming dies at Lepman Bros. Co., Chicago—manufacturer of women's hats.

AT NO EXTRA COST, the flexible connectors shown above were all specially designed by American . . . and furnished with appropriate end fittings attached . . . for a variety of specific applications.

In conveying countless substances under conditions of vibration, misalignment, movement or restricted space—flexible metal lines or connectors have solved thousands of industrial problems. Why not give American *your* problems involving flexible connections and help simplify the jobs of your design and production departments?

American Seamless Flexible Metal Tubing, made from seamless bronze tube corrugated for maximum flexibility, is standard in sizes ⅛" to 4" I.D. – reinforced as required with bronze wire braid. American Metal Hose is manufactured in four spirally wound types – available in brass, bronze, aluminum, steel and other metals in sizes ⅛" to 12" I.D.

Write for literature . . . and always feel free to consult our Technical Department.

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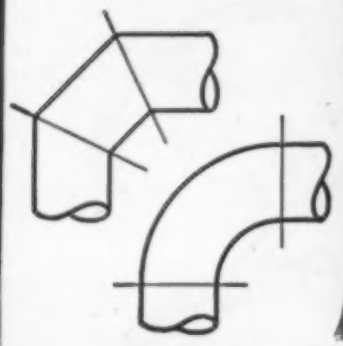

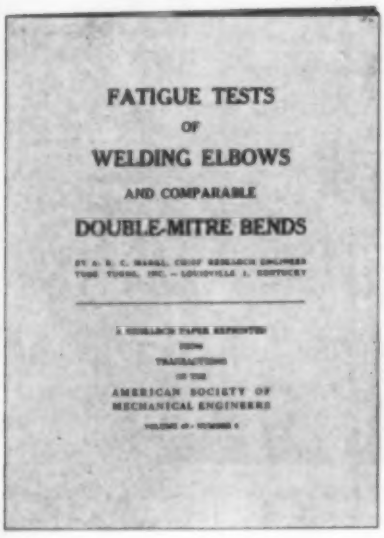

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chief process engineer, is now assistant engineering manager. **Arthur W. Pratt** becomes chief process engineer, and **N. J. Carter**, assistant chief.

T. W. Jones, editor and manager of our British contemporary *Chemistry and Industry*, is in this country. His trip includes visits in Montreal, Chicago, Washington and other points of contact with friends in the chemical and chemical engineering professions.

T. W. Jones

J. B. Weaver

James B. Weaver, of the research and development staff of Godfrey L. Cabot, Inc., Boston, has been transferred to Pampa, Tex. He will spend about a year in Texas studying manufacture and quality control of carbon black.

R. S. Wobus, manager of the Monsanto Chemical Co. plant at Norfolk, Va., has been promoted to the newly-created position of assistant to the plant manager of the John F. Queeny plant in St. Louis. Wobus will be succeeded in Norfolk by **James H. Zwemer**, who has been assistant plant manager there. **Karl Ellingson**, a supervisor at the Queeny pilot plant, will in turn succeed Zwemer as assistant plant manager.

D. M. Aumack has been appointed to the newly created position of manager of the effluent department of the Calco Chemical division of the American Cyanamid Co., of Bound Brook, N. J.

Jerome Alexander, consulting chemist of New York City, has been elected honorary member of the Association of Consulting Chemists and Chemical Engineers.

Harold Naidus has joined the research staff of the American Polymer Corp., Peabody, Mass. The appointment is part of the company's plans to expand its work on polymer research and the development of the new products for industry.

Jerome P. Morgan, chemical engineer in the development division of the Standard Oil Development Co., Elizabeth, N. J., has been named an adjunct

Are YOU Working in the DARK . . . With HIGH PRESSURES?

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TESTED to 20,000 Pounds Pressure

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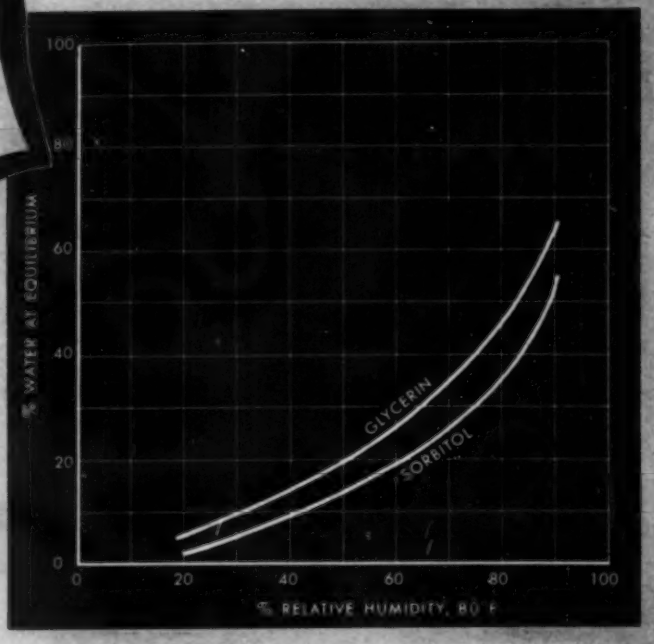
SORBITOL . . .
the Conditioning Agent that is Different!



Sorbitol is a polyhydric alcohol with many unique properties which make it valuable in certain types of processing and synthesizing. Its narrow humectant range, illustrated by the chart, is one of sorbitol's advantages as a conditioning agent.

SORBITOL has a Narrow Humectant Range

When a solution of sorbitol is transferred from one relative humidity to another, the percent moisture change is considerably less than when the same procedure is carried out with other polyhydric alcohols under the same conditions.

Sorbitol also *dries out more slowly* at low humidities and *picks up moisture at a slower rate* at high humidities. It is *more viscous*. It is *non-volatile*. Sorbitol is *compatible* with other materials normally encountered in conditioning problems and its *chemical stability* keeps it from breaking down or decomposing in use.

Sorbitol is readily available in large quantities. Purity is the highest ever. Its price is not subject to wide variation and the trend is downward.

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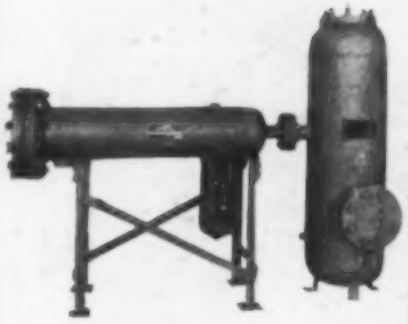

FOR AIR LINES

AND

INSTRUMENT LINES

The same principle of two-stage dehydration works as in the case of liquid propane. By removing all appreciable free water, or condensate, in the Excel-So Separator, the dehydrating chamber has very little work to do—and may be reduced to a small size vessel—small enough to hold multiples of 1, 2, 3, 4, or 5, 100# factory packed and hermetically sealed bags of dessicant. At this small replacement cost, the material may be thrown away, at less expense than the cost of regeneration equipment.

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professor of chemical engineering at Stevens Institute of Technology, Hoboken. He is one of eight engineers appointed from industry as adjunct professors in fields of graduate study at Stevens under a new policy adopted by the board of trustees.

Frank A. Jones has been appointed chief engineer of Dearborn Chemical Co. **E. A. Goodnow**, whom he succeeds, has relinquished his position due to ill health but will remain with the company as assistant chief engineer.

J. C. Weaver

C. A. Coffey

J. C. Weaver has been placed in charge of integrating and routing vehicle and resin problems of the Sherwin-Williams Co. among research, development and production divisions of S-W and its affiliated companies. **C. A. Coffey** has been appointed assistant director of resin research in Chicago.

Henry R. Black, formerly of Owens-Corning Fiberglas Corp. and more recently with Australian War Supplies Procurement in Washington, has returned from Australia to serve as U. S. resident director for Idelco at Wilton, Conn. Idelco is an organization for the development of reciprocal trade between the United States and Australia.

W. B. Pings

S. Kahn

W. B. Pings has been employed by Godfrey L. Cabot, Inc., Boston, to head up a newly established group working in the field of organic chemistry. **Samuel Kahn** has been added to the Cabot laboratory staff. He will work with Dr. Pings.

John T. Rettaliata, director of the department of mechanical engineering at Illinois Institute of Technology, will become dean of engineering next September 1. Dr. Rettaliata will fill the position vacated by **James C.**

SAFETY FOR FACTORY WORKERS

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6 out of 150 Cesco products are shown above. They represent what CESCO can do to protect your workers, no matter what your needs may be. For quality safety equipment, check CESCO every time.

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TO ASSURE the maximum efficiency built into the machine itself, this centrifugal refrigeration unit requires a lubricating oil that will do double-duty as a "watch-dog."

For here oil must not only protect the mainshaft and bearings against wear, but also must help to maintain the seal to prevent loss of valuable refrigerant.

A free-flowing, highly stable Gargoyle Oil has proved to be an ideal lubricant on the bearings, and an effective seal against loss of refrigerant or admission of air. In constant circulation over long periods of time, it resists the formation of deposits. It protects, even when diluted with Freon refrigerant.

Match the long-lived dependability of your refrigeration units with this equally dependable lubricant.

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Peebles in August after more than 40 years service at the technological institute.

Glenn T. Seaborg of the University of California received the William H. Nichols Medal of the American Chemical Society's New York section, March 5.

C. Fred Gurnham has established an office as a consulting chemical engineer in Hamden, Conn. Dr. Gurnham will specialize in chemical manufacture and industrial waste disposal.

W. B. Golush has been appointed manager of the Houston area gas-gasoline department of Shell Oil Co. A chemical engineer, Golush was an assistant department manager in the company's plant at Dominguez, Calif., prior to his transfer to Houston last September to become a senior engineer in the regional gas-gasoline department.

Allan W. Low has been appointed general superintendent of a new formaldehyde plant of Monsanto Chemical Co.'s plastics division in Springfield, Mass.

Gordon F. Dittmar, formerly a member of the synthetics division at Hercules Powder Co.'s experiment station, has been transferred to sales research division in the company's home office at Wilmington.

David D. Moore, chemical engineer, has joined the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in research in engineering economics.

A. H. Ingley has been appointed vice-president in charge of operations for the Diamond Alkali Co., which has moved its headquarters from Pittsburgh to Cleveland. **M. O. Kirp** was named to succeed Ingley as general manager of the Painesville plant.

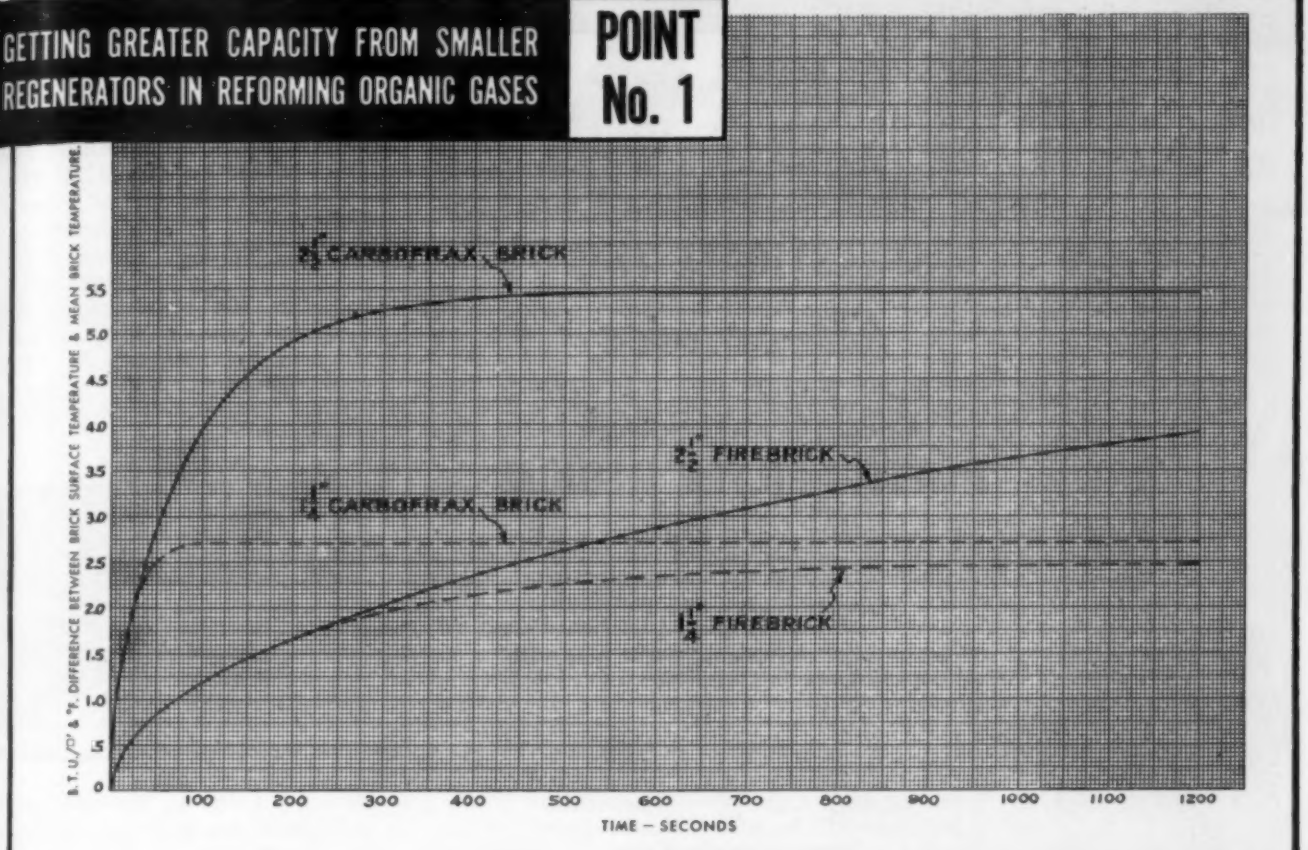
J. E. Hobson, formerly director of Illinois Institute of Technology's Armour Research Foundation, Chicago, has been appointed director of Stanford Research Institute, Palo Alto, Calif., following resignation of **William F. Talbot.**

Carrol M. Beeson, formerly supervisor of the production section, laboratory department, General Petroleum Corp., Los Angeles, has been named associate professor of petroleum engineering at the University of Southern California, Los Angeles.

Albert V. Collins has resigned his position as assistant chief chemist at

GETTING GREATER CAPACITY FROM SMALLER REGENERATORS IN REFORMING ORGANIC GASES

POINT No. 1



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In 75 seconds, standard 9" CARBOFRAX silicon carbide brick absorb by conduction as much heat per degree temperature difference as same size firebrick do in 910 seconds. Charted comparison points up this difference.

Faster heat absorption provides several advantages. Heating-up time is cut. Operating cycles are faster. Heat saturation is practically complete. Capacity is increased with same fuel consumption. Enormous checkerwork structures are unnecessary. Smaller regenerators can be used. Initial plant and equipment costs are slashed.

Heat conductivity 11 to 12 times that of fireclay is the explanation. CARBOFRAX checkers are heated throughout far faster. On reversals, heat is released just as quickly. This means fewer CARBOFRAX checkers are required. It assures shorter cycles with greater production.

To obtain top efficiency through the use of CARBOFRAX checkers, special attention to regenerator design is essential. The services of our engineers are available for advice and assistance. Dept. L-48, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.

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Offered by CARBOFRAX Checkers

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2. Faster Saturation
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4. High Refractoriness
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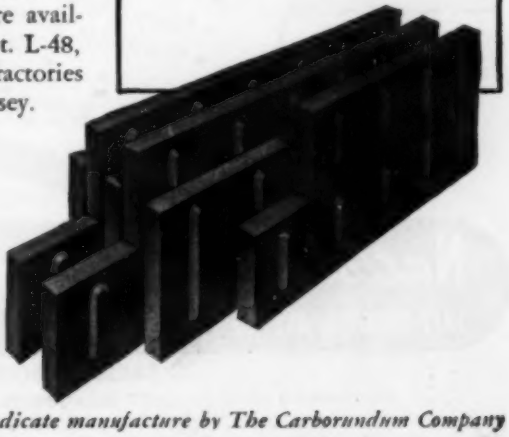

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PLASTIC FILTER MEDIUM

"All-service" because SARAN is highly resistant to most acidic and caustic chemicals... much more so than conventional cotton fabrics, even treated fabrics. Test runs on the following chemicals, with "good to excellent results," prove the resistant qualities of SARAN.

10% Acetic Acid	Acetone
10% Hydrochloric Acid	Benzene
10% Nitric Acid	Ethyl Alcohol
30% Sulphuric Acid	Formaldehyde
20% Sodium Hydroxide	Bleach Solution

Saturated Bromine Water
10% Sodium Chloride

"Hot chemical" because SARAN is unaffected chemically or mechanically by continuous exposure to many chemicals up to 160° F. or by the intermittent exposure up to 212° F.

No special installation methods are needed when using SARAN. Order and install it as you would conventional filter media. Before ordering, however, perhaps you would like to try it out for its resistance. In writing for a test sample of SARAN, tell us about the products you wish to filter with it.

The FM Line of Filter Media includes:

- Cotton Filter Cloth
- Glass Filter Cloth
- Synthetic Fiber Cloths

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The Correct Medium for any Problem

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Shell Chemical Corp., Houston, to become associated with the McGean Chemical Co., Cleveland, Ohio.

Wilbur A. Lazier has been appointed director of chemical research for Chas. Pfizer & Co., Inc., Brooklyn. Prior to 1944 Dr. Lazier headed a research group in the chemical department of E. I. du Pont de Nemours at Wilmington, and for the past three and one-half years has been director of the Southern Research Institute at Birmingham, Ala. **William M. Murray, Jr.**, has been promoted to acting director at Southern Research Institute succeeding Dr. Lazier.

W. A. Lazier

P. L. Fahrney

Paul L. Fahrney, formerly general manager of operations in the marketing department has been elected a vice president of Standard Oil Co. of California, San Francisco.

John A. Hutcheson has been appointed director of the Westinghouse Research Laboratories, succeeding L. **Warrington Chubb.** Dr. Chubb, who is retiring from active direction of the laboratories for reasons of health, has been named director emeritus and will continue to serve in an advisory capacity.

OBITUARIES

Povl Ostergaard, 48, chief process engineer of Gulf Oil Corp., died in Pittsburgh, February 17.

Arthur E. Barnard, 54, inventor's counsellor for United States Rubber Co., died of a heart attack at his home in Manhassett, N. Y., February 23.

W. G. Willard, 67, engineering chemist for the Spartanburg, S. C., metropolitan district, died in Charlotte, N. C., February 24.

Martin Newcomer, 64, assistant director of research of the Winchester Repeating Arms Co. division of Olin Industries, Inc., died at his home in Cheshire, Conn., February 24.

George Stuart Monroe, 55, for the past 24 years a research chemist with the Universal Oil Products Co., died suddenly, February 25.

The ABC's of Casting Problems

A stands for Abrasion, which wears a casting until its effectiveness is gone. B stands for BTU's

(heat) which oxidizes castings, destroys their physical properties. C is for Corrosion

which eats away the casting until it fails in service.

54-inch turbine runner cast of ESCO stainless steel. Casting weighs over 4,800 pounds.

These are problems that increase operating costs, cause shutdowns, and cut production. But there is an ABC answer — turn them over to *ESCO*.

For years *ESCO* engineers and metallurgists have fought abrasion, heat and corrosion in pulp mills, and chemical, cement and food processing plants all over the world. Problems of all kinds have been met, individually attacked and individually solved. In this way a great fund of experience and knowledge has been built. This enables *ESCO* not only to select the best alloy steel for a given purpose, but also to design and make the equipment itself, whether it be a small specialized fitting or a huge casting like the one shown at the right.

This experience often points the way to lower operating costs and increased production. It is available to you. Consult your nearest *ESCO* representative, or write us about your problem. No obligation, of course.

Up-to-Date Information Available

Periodically *ESCO* issues bulletins on developments in stainless steel metallurgy. To receive this data, simply fill in and mail the coupon below.

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IMPREGNATED FILTER CLOTH

for filtering Caustic and Alkaline Solutions

Learn how you can greatly increase the life of your cotton filter fabrics—overcome danger of mildew—reduce clogging, gumming and washing—keep presses running longer—increase production—improve filtration—and cut costs. Write for your free copy of booklet TODAY.

Samples on request.

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LODI, NEW JERSEY

INDUSTRIAL NOTES

United States Steel Corp., Chicago, has named Robert C. Myers manager of the market development division of their subsidiary, Carnegie-Illinois Steel Corp.

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has appointed Charles W. Young plant manager.

Rapids-Standard Co., Grand Rapids, Mich., has elected James R. Sebastian president and general manager. He succeeds Lloyd C. Backart who was named chairman of the board of directors.

Calumet Iron & Supply Co., East Chicago, Ind., has made Norman Weinstein vice president in charge of their Calisco Engineering division. He was formerly with the Trane Co.

United States Steel Corp., Chicago, has appointed William B. Renois general manager of sales of their subsidiary, Gerrard Steel Strapping Co.

Lincoln Electric Co., Cleveland, has appointed H. E. Cable district manager of their Pittsburgh office. J. S. Roscoe has been made district manager for the Chicago office.

American Home Products Corp., New York, has changed the name of its subsidiary, International Vitamin Corp. to International Vitamin division, Ives-Cameron Co., Inc.

Detecto Scales Inc., Brooklyn, N. Y., has bought a five-story factory building and penthouse at 540 Park Ave., between Nostrand Ave. and Sanford St., Brooklyn. The move is to consolidate the manufacturing operations of the company under one roof.

Flexible Tubing Corp., Branford, Conn., has begun operations. Frederick K. Daggett is president and treasurer. Joseph B. Morse is secretary.

U. S. Electrical Motors, Inc., is doubling the size of its plant in Milford, Conn. There will be no interruption of manufacturing during the expansion.

American Cyanamid Co., Bound Brook, N. J., has appointed John Rhodes a sales representative in the Philadelphia territory for its Calco Chemical division.

Monsanto Chemical Co., St. Louis, has made Tom K. Smith, Jr., assistant

PUMPING *Hot Viscous Liquids*

Sulphur

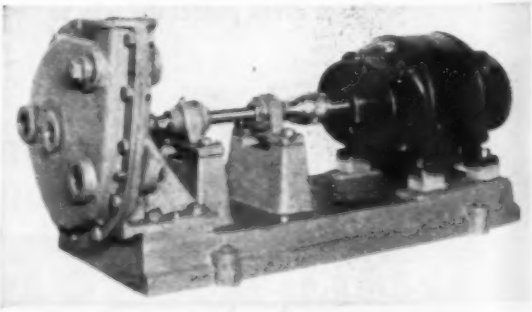
Molasses

Glue

Tar

etc.

Many heavy, viscous liquids can be pumped only at high temperatures. Sulphur, for example, if not kept hot enough, would solidify and clog the system. To meet difficult requirements such as this, Lawrence engineers design steam-jacketed centrifugal pumps for the specific liquid and temperature range involved. Illustrated is a regular side-suction pump entirely enclosed in a steam jacket which also covers the intake and stuffing box. The pump and liquid within are kept at the steam temperature. Write us the details of *your* pumping problem. We'll be glad to discuss it with you—without obligation.



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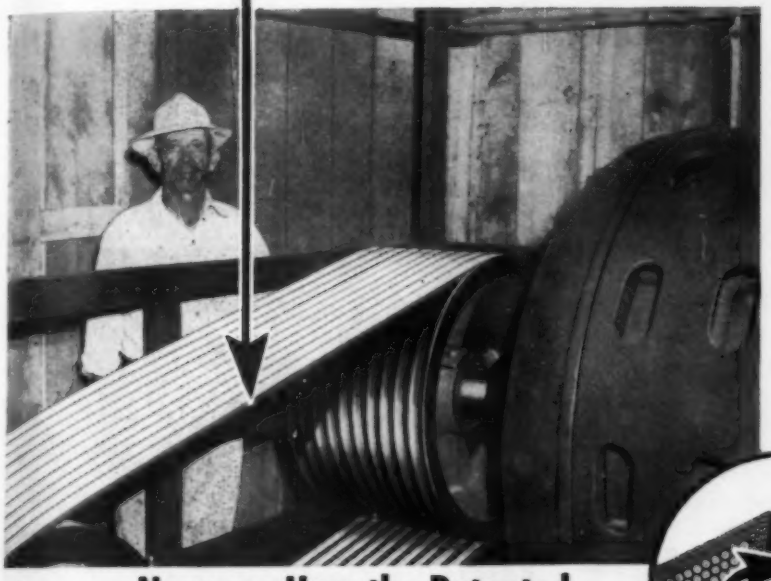
The SIDES of a V-Belt . . .

Diagram of V-Belt in Sheave Groove

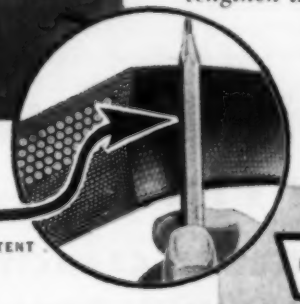
Really DRIVE the Pulley
They PICK UP and DELIVER the POWER!
Naturally They GET the WEAR



Anyone experienced with V-Belt drives knows that the *sides* of a V-Belt are what really get the wear.

It's the *sides* that grip the pulley. They pick up all the power from the driver pulley, transmit that power to the belt as a whole and then, once more, deliver the power to the driven pulley. Moreover, it's the sides that take all the wear against the sheave-groove wall.

That is why you have always noticed that the *sidewall* of a V-Belt is the part that *wears out first*—and, naturally, if you prolong the life of the sidewall, you *lengthen* the *life* of the *belt!*



Now see How the Patented Concave Side

A GATES PATENT

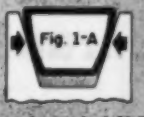
SAVES Sidewall Wear ...Lengthens Belt Life

The simple diagrams on the right show exactly why the ordinary, straight-sided V-Belt gets excessive wear along the *middle* of the sides. The diagrams show also why the Patented Concave Side greatly *lengthens the life* of the *sidewalls* of Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belt can possibly give.

Saving SIDEWALL WEAR is more important NOW than ever before.

Now that Gates *SPECIALIZED* Research has resulted in Super Vulco Ropes capable of carrying much heavier loads—fully 40% higher horsepower ratings—the sidewall of the belt is called upon to do even more work in transmitting these heavier loads to the pulley. Naturally, with heavier loading on the sidewall, the life-prolonging Concave Side is more important now than ever before!

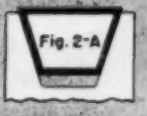
Straight Sided V-Belt



How Straight Sided V-Belt Bulges When Bending Around Its Pulley

You can actually feel the bulging of a straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.

Gates V-Belt with Patented Concave Sidewall



Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt Is Bending Over Pulley.

No bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!

THE GATES RUBBER COMPANY *"The World's Largest Makers of V-Belts"* DENVER, U.S.A.

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Gates

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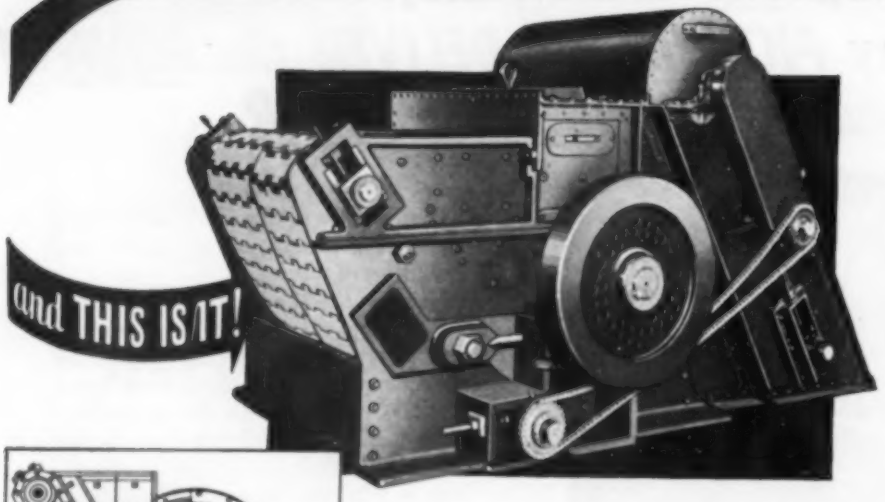
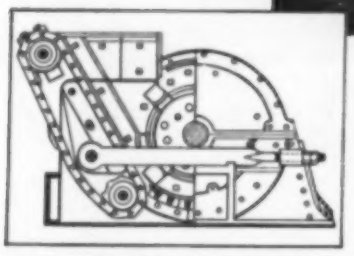
Engineering Offices and Jobber Stocks **IN ALL INDUSTRIAL CENTERS** of the U. S. and 71 Foreign Countries

There IS a difference in HAMMERMILLS





Uniformly high quality of product . . . enormous crushing power . . . lower drying costs . . . result from the Continuously Moving Breaker Plate . . . the patented non-clog feature that accounts for Dixie's greater efficiency. At left—Sectional View of the Dixie Non-Clog Hammermill.

Dixie's distinguishing feature, the Moving Breaker Plate*. . . is your guarantee of

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- MAXIMUM PRODUCTION
- ECONOMY OF OPERATION

The Continuously Moving Breaker Plate, the vastly improved non-clog crushing principle developed and perfected by Dixie engineers, has demonstrated its superiority in the reduction of raw materials in hundreds of installations all over the world. There's only one Dixie Hammermill. Don't be misled by claims of "just as good." Make it a Dixie . . . and make sure!

*U. S. Patents Granted and Pending.

DIXIE

DIXIE HAMMERMILLS FOR CRUSHING GRINDING • PULVERIZING • SHREDDING

Our latest bulletin, "More Efficient Crushing of Raw Materials," convincingly sums up Dixie's unique money-saving features. Request your copy today.

DIXIE MACHINERY MFG. CO.

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branch manager of its phosphate division. He is in charge of the Cincinnati branch of the Detroit office.

Pan American Petroleum Corp., New Orleans, has purchased a majority of the stock of Root Petroleum Co. New president of Root will be Dwight F. Benton. D. P. Hamilton, former president, will continue as a director. There are no other personnel changes.

Rohm & Haas Co., Philadelphia, has dissolved its subsidiary, Charles Lennig & Co. In the future it will operate as the Charles Lennig division of the parent company.

Hammermills, Inc., St. Louis, is the name of a recently organized Hammermill company. C. M. Binder is president and T. A. Oberhellmann is vice president and chief engineer.

Diamond Alkali Co., Fairport, Ohio, has planned an extensive program of new construction work for the coming year. A new department, magnesium oxide, has recently been completed.

Bemis Bro. Bag Co., St. Louis, Mo., has named Bradford R. Stetson as office assistant in the general production department.

Merck & Co., Rahway, N. J., has announced plans to add new buildings and equipment for the production of antibiotics at its Elkton, Va., plant.

Luminous Industries Inc., New York, has been formed with Erwin Schapira, formerly Assistant District Attorney of New York, as president and treasurer.

Commercial Solvents Corp., New York, has merged its New York and Boston district sales offices into the metropolitan district office. R. L. Hutchins, formerly manager of the New York district office, has become manager of the new office. The sales department's agricultural division has been enlarged and reorganized with Daniel B. Curll, Jr., as manager.

H. K. Ferguson Co. has announced the addition of Robert H. Fuller to their staff of contract engineers.

Blaw-Knox Co., Pittsburgh, has been appointed by Emery Industries Inc. as exclusive licensing agent in Great Britain for the continuous fat splitting process covered by patents of Procter & Gamble Co. and Emery Industries Inc.

Standard Oil Co. (Indiana) has appointed Milton A. Dixon manager of

ENGINEERING PROGRESS REPORT # 12

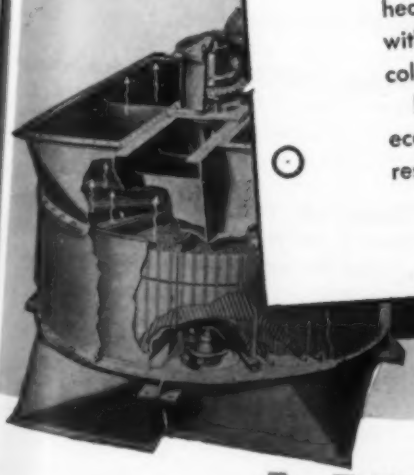
LJUNGSTROM AIR PREHEATER

CORROSION-RESISTANT ALLOY FOR HEATING ELEMENTS

The removable cold end of the Ljungstrom heating element (upper left) and sections from which the cold end has been removed for purposes of illustration.

In the Ljungstrom, the replaceable cold end is made from a special corrosion-resistant alloy that reduces maintenance and replacement. In addition, the heating elements at the cold end are made from heavier gage metal to withstand the impact of the mass soot blower and lengthen the life of the cold end.

Replacement of the cold end of the heating surface is rapid, easy and economical. Standard equipment on all new installations, corrosion-resistant cold ends can be applied to older Ljungstrom air preheaters.



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AIR PREHEATER
CORPORATION

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Automatic proportioner . . . for two or more liquids . . . with patented, precision volumetric meter control. Records quantity of each ingredient as well as finished product.

Automatic unit fills containers in predetermined quantities—one pint to nine quarts. Temperature control and specific gravity adjustment.

Bowser Industrial Xacto Meters accurately measure liquids ranging from acids to wood oil. Gray cast iron, brass, bronze or stainless steel construction.

--to share the experiences of other plant men who have--

REDUCED PRODUCTION COSTS with Bowser Xacto meters

You are invited to explore the possibilities for similar economies in your plant through:

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3 Accurate inventory control.
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LIQUID CONTROL SPECIALISTS SINCE 1885

bulk sales in the lubricating department.

Monsanto Chemical Co., St. Louis, has opened a sales office in Portland, Ore.

Bailey Meter Co., Cleveland, has expanded its staff of field engineers.

E. I. du Pont de Nemours & Co., Wilmington, has appointed Harold E. Goldsmith sales manager for the Boston region of the fabrics and finishes department.

Blaw-Knox Co., Pittsburgh, has been contracted by Lever Brothers and Unilever Ltd., London, to design and build a plant for the production of stearic and oleic acids by the Emersol process.

Hyster Co., Portland, Ore., has made Fay Brainard assistant general manager. Svante Eikrem succeeds him as plant engineer of the Portland plant.

Lukens Steel Co., Coatesville, Pa., has added Charles W. Rippie to its sales development staff.

B. F. Goodrich Chemical Co., Cleveland, has formed a department to handle the sales of new chemical products.

Link-Belt Co., Chicago, has established a district sales office in Charlotte, N. C., with Thomas H. Appleton as manager, and one in Wilmington headed by W. H. Kinkead.

Hardinge Co., York, Pa., has appointed the Chavigny Co., Houston, as sales agent for its pulp and paper, water works, and sewage equipment in southern Texas.

National Industrial Conference Board, New York, has elected Leonard T. Beale, president of the Pennsylvania Salt Mfg. Co., to its membership.

Tarnell Co., Inc., New York, has been formed to provide credit reports on customers of chemical raw materials suppliers.

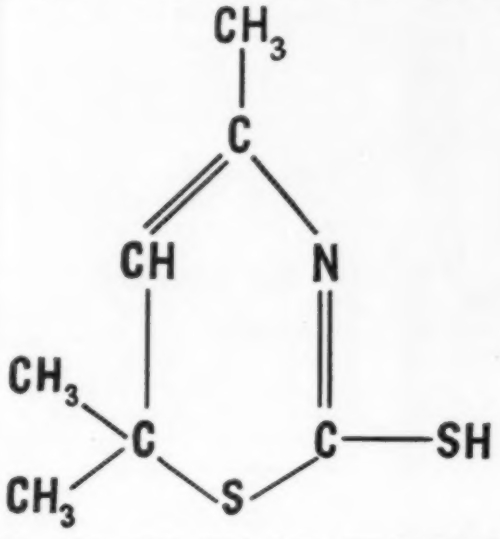
Dow-Corning Corp., Midland, Mich., has opened a branch office in Dallas, Tex. Max H. Leavenworth will head the office.

Baker Ice Machine Co., South Windham, Me., has elected Albert F. Milton treasurer.

Link-Belt Co., Chicago, has moved its Pittsburgh district sales office to 5020 Centre Ave. Plans are being made for

3 Chemicals

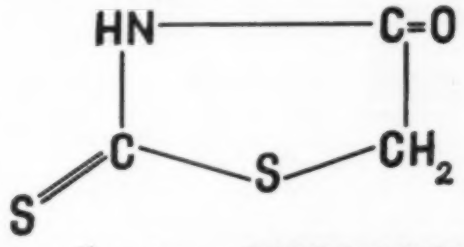
THAT MAY OPEN UP NEW FIELDS



Good-rite M.T.M.T.

2-Mercapto-4,6,6-Trimethyl Thiazine

As an intermediate, M.T.M.T. is expected to find many applications in the manufacture of wetting agents, pharmaceuticals, and other specialty chemicals not heretofore possible. As a new composition of matter, its chemical structure will suggest utility in a wide variety of fields.



Good-rite RHODANINE

2-Thio-4-Keto-Thiazolidine

This material is soluble in alcohol, ether, alkali, and hot water. Rhodanine reacts readily with aromatic aldehydes and the resulting derivatives are useful as intermediates for the manufacture of arylamino acids, arylthio-pyruvic acids, arylacetonitriles, and arylethyl amines, all with unusually high yields.

$NH_2\text{-}CH_2\text{-}CH_2\text{-}OSO_3H$

Good-rite A.E.S.A.

2-Aminoethyl Sulfuric Acid

Source of Ethylene Imine. Suggested for use in the paper industry to increase wet strength and water repellency. Recent laboratory work indicates interesting results in the treatment of cotton fibres. Since aminoethyl sulfuric acid reacts with most compounds containing an active hydrogen atom, the material is widely applicable as an aminoethylating agent.

For detailed technical bulletins on these chemicals please write Department CD-4, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

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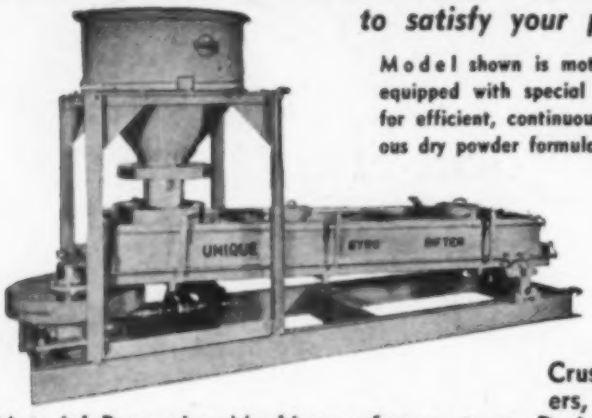

Model shown is motor-driven . . . equipped with special telescopic hopper for efficient, continuous feeding of various dry powder formulations.

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new office and factory-branch store buildings to be erected on the site. The Pittsburgh office is headed by Otto W. Werner. Richard J. Joyce has been appointed purchasing agent for the company's Indianapolis plants succeeding Frank C. Thompson who is retiring.

Steamaster Automatic Boiler Co., Los Angeles, has announced the opening of a midwestern branch office in Chicago. Joseph Sullivan has been made general manager.

Midwest Research Institute, Kansas City, Mo., has formed a new pharmaceutical chemistry section.

Filter Paper Co., Chicago, has been appointed distributor of Thomson Pumps for the Chicago area.

Distilled Spirits Institute, Washington, D. C., has elected R. E. Joyce president.

Monsanto Chemical Co., St. Louis, has appointed Frederick W. Meuschke assistant sales promotion manager of its plastics division.

Nuodex Products Co., Elizabeth, N. J., has moved its western division office to larger quarters at 505 North La Salle St., Chicago.

Reynolds Metals Co., Louisville, Ky., has named Leon Norfleet industry manager of its marine division.

Spencer Chemical Co., Kansas City, Mo., has appointed H. R. Dinges sales manager of the chemical and fertilizer department. J. E. Culpepper has been made assistant general sales manager. William Schopflin has been appointed chemical sales supervisor.

Hubbard-Moslo Co., Cleveland, has been incorporated by Sterling W. Hubbard, Jr., who is associated with the Celanese Corp. of America.

Patterson Chemical Co., Dayton, Ohio, has been incorporated by Robert Patterson. The firm has been chartered as an industrial chemical company. The incorporators are W. Walker Lewis, Jr., Boyd M. Compton and Ford Ekey.

Chlorine Institute has elected W. H. Sheffield, Jr., a director. Mr. Sheffield is secretary and member of the board of directors of Innis, Speiden & Co.

Eutectic Welding Alloys Corp., New York, has appointed Theodore I. Leston vice president in charge of production.

for heat transfer service

Trentweld

STAINLESS STEEL TUBES pay for themselves in TIME

They save TIME *by the hour* in installation

They gain TIME *by the year* in length of service

Today, time runs into money, more money than ever before. If you agree with this, then the advantages of Trentweld stainless steel tubes are for you . . . for here is heat exchanger tubing, made to specifications that cut costs — all costs.

To begin with, Trentweld tubes are thin-walled and have a soft temper. They roll or weld into tube sheets easily. All tolerances are held to micrometer limits to provide pressure tight joints easily. They go in fast, makes a smooth-running, time-saving job of installation. More than that, all Trentweld tube is pressure-tested, is pickled for increased corrosive resistance and is flare-tested for ductility. Back of these precision standards is an exclusive method of rolling and fabricating stainless tubing that gives Trentweld performance stamina not to be found anywhere else.

These are only the highlights on this work-horse tube. All of the facts are yours for the asking. Call on Trentweld engineers, without obligation, for specific information, or write for the Trentweld Data Bulletin.

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Your comprehensive guide to the chemical process industries

A reference manual of present-day procedures —broken down into unit processes and unit operations

THIS important 957-page manual makes available in handy reference form a tremendous compilation of authoritative data on the most modern procedures used in the manufacturing of chemicals and chemical products. Here you have a cross-section of the chemical process industries, with the basic procedures for each analyzed and described by flow sheets showing the unit processes and unit operations.

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- plastics
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- explosives
- petroleum and wood products
- synthetic fibres
- paint, varnish and lacquer
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- perfume and flavoring
- sugar and starch products

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CONVENTION PAPER ABSTRACTS

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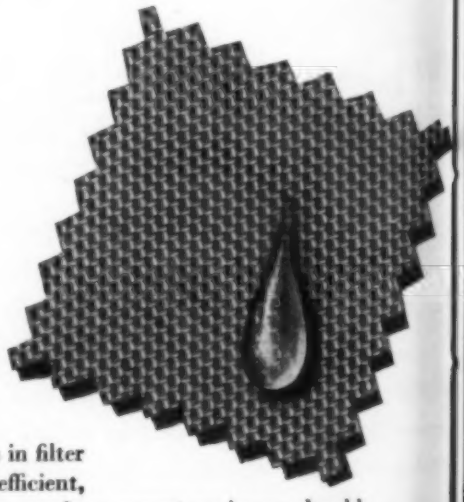
Home-Grown Motor Fuel

THE USE of alcohol as a motor fuel now turns on price. At present prices of grain, alcohol is too expensive. But alcohol as a motor fuel offers not only the most feasible large-scale industrial outlet for surplus grains, but also offers the petroleum industry significant help in extending its supplies of motor fuels from available crudes. The enormous increase in the use of liquid fuels will be stopped only by our capacity to produce them. Under present and future conditions, alcohol should not be considered a competitor of gasoline, but a supplement. Alcohol may prove even more advantageous to the petroleum industry than as a market outlet for agriculture.

Several "ifs" enter into the use of alcohol for motor fuels at present which may not be nearly so significant within the next few years. A current drawback to the use of alcohol-gasoline blends is the price of alcohol. Even with dollar corn, alcohol will cost 50-c. a gal., while the current price of gasoline is in the 25-c. range. On the other hand, regardless of this difference in price, in heavy-duty engines under heavy loads at full throttle, there are many instances where the use of alcohol-water injection with low-grade gasoline will be cheaper and give better operation than premium grade gasoline.

The fuel characteristics of alcohol have received much attention at the Northern Regional Research Laboratory to determine in what ways alcohol may be outstanding as a motor fuel. This work has concerned the use of alcohol-gasoline blends of various ratios and that of direct injection of alcohol-water mixtures. As a motor fuel, alcohol approaches isooctane which has an octane rating of 100. In fact, alcohol increases the octane

the right filter base



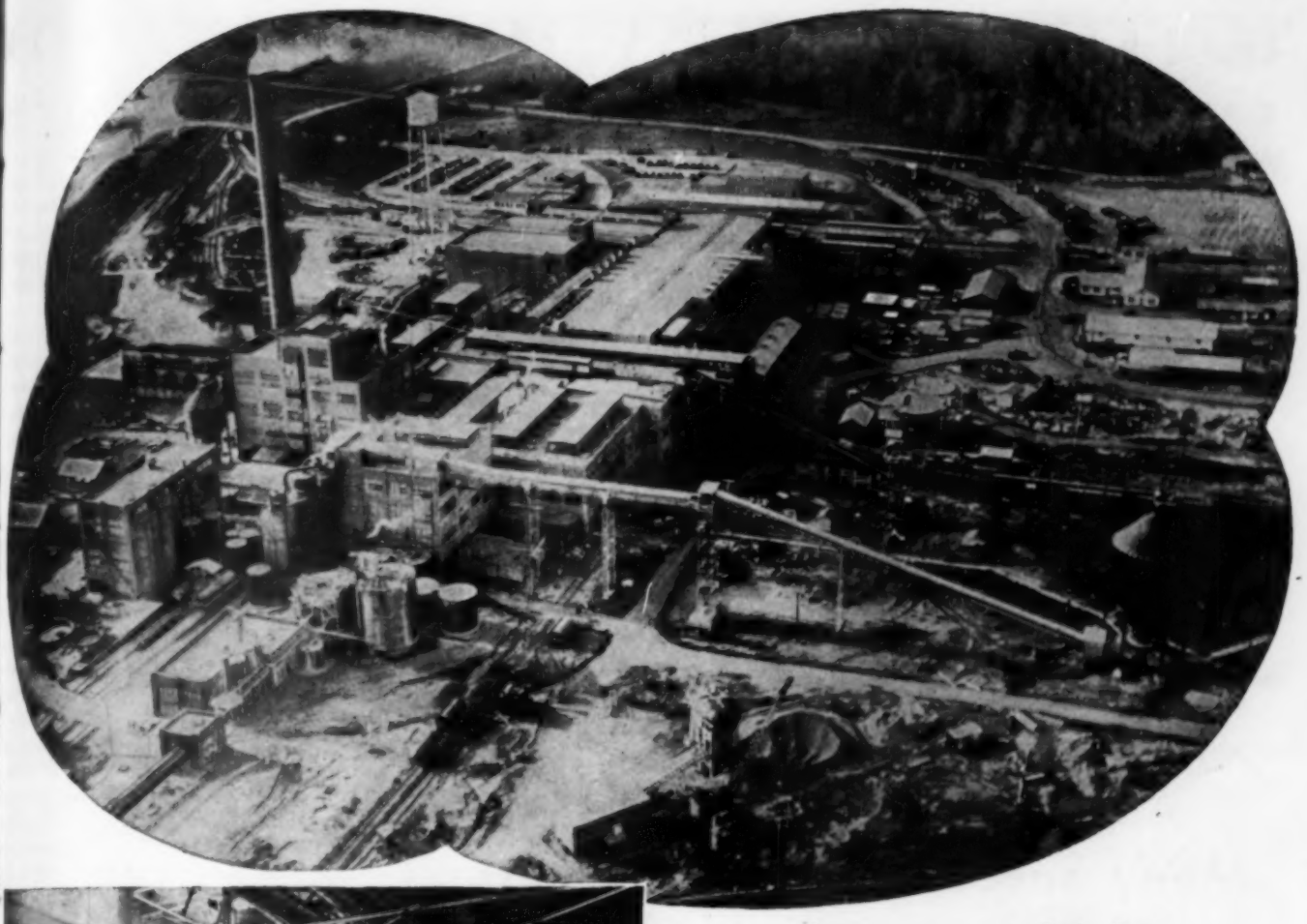
● It's dangerous to guess in filter base selection. If you want efficient, economical filtration for your product, expert engineers should recommend the *right* base. Sperry, with more than 50 years filtration experience, can do just that.

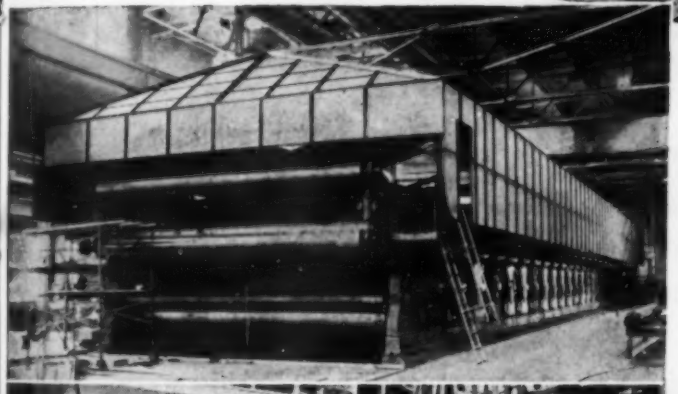
Sperry has a complete stock of bases, too. All types and materials: paper, cloth, wool, vinyon, asbestos, rubber, and woven metals as well as special bases to meet unusual requirements.

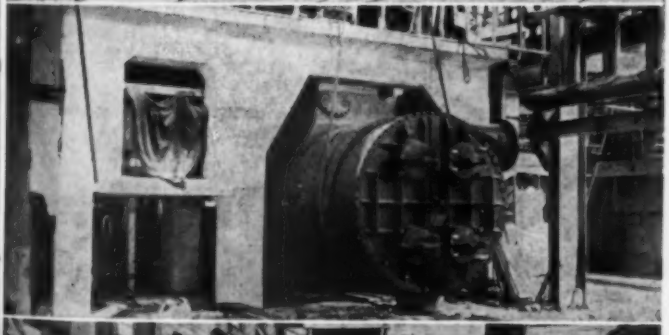
Let Sperry analyze your filtration problem, now. There's no obligation and you're certain to improve your production efficiency.

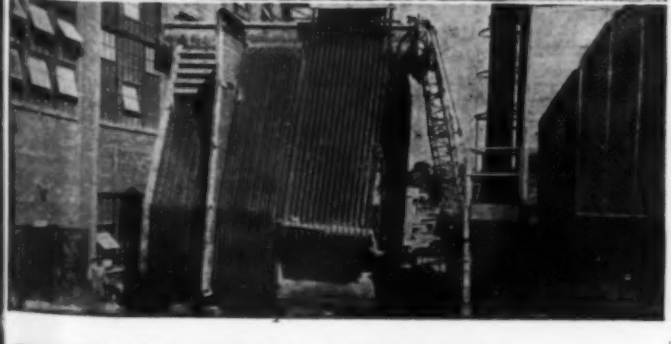
D. R. SPERRY & COMPANY, *BATAVIA, ILLINOIS*
Filter Base Division

SPERRY FILTER BASES









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= 350 tons daily

Doubling the production involved very substantial increases in power output, expansion of existing buildings, construction of new buildings, installation of new machinery, moving of old facilities, work of every type—and all the time manufacture of critical newsprint had to go on.

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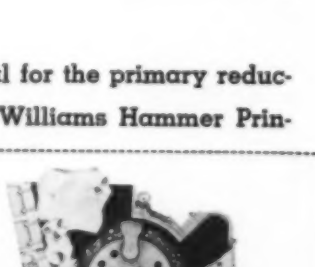

Sectional view of Williams Hammer Crusher showing how the heavy, free swinging hammers reduce the material to desired size.

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number of any gasoline whose octane number is less than 92. For example, a gasoline with an octane rating of 60, if blended with 25 percent of ethyl alcohol, will make a motor fuel of 79 octane rating. A 10 percent alcohol-gasoline blend will give excellent performance in engines, being equal to or better than a good grade, premium gasoline. The use of such a blend requires no change in engine design or adjustment.

Direct injection of alcohol-water mixtures into engines, a development used during the war, enabled airplanes to obtain increased power for extra bursts of speed. Since the war attention has been given to its application, especially in trucks. Recently a device has appeared on the market which permits use of alcohol-water injection in passenger cars. Studies at the Northern Laboratory show that by alcohol-water injection, an engine supplied with a low-grade gasoline having an octane number of 55 will perform, under stress, as if it were being fed a good grade, regular gasoline. And with present devices available, a car that would operate well on low-grade fuel at constant speed on a level road, could automatically have the advantages of alcohol-water injection to make it perform under stress as well as if it were supplied with high-grade fuel. This will eliminate the necessity of high-grade gasoline at all loads and aid in the conservation of petroleum resources.

G. E. Hilbert, U. S. Department of Agriculture, before National Farm Chemurgic Council, Omaha March 5, 1948.

Statistical Concepts Make Better Insecticides

KILLING power of HETP, a German-born insecticide that controls pests which defy DDT, has been greatly increased as the result of a statistical study of atomic geometry. HETP, or hexaethyl tetraphosphate, is an excellent substitute for the nicotine compounds widely employed for killing soft-bodied insects, a type resistant to most other insecticides. HETP is not a pure chemical compound as its name implies, but instead a mixture of several active and inactive ingredients.

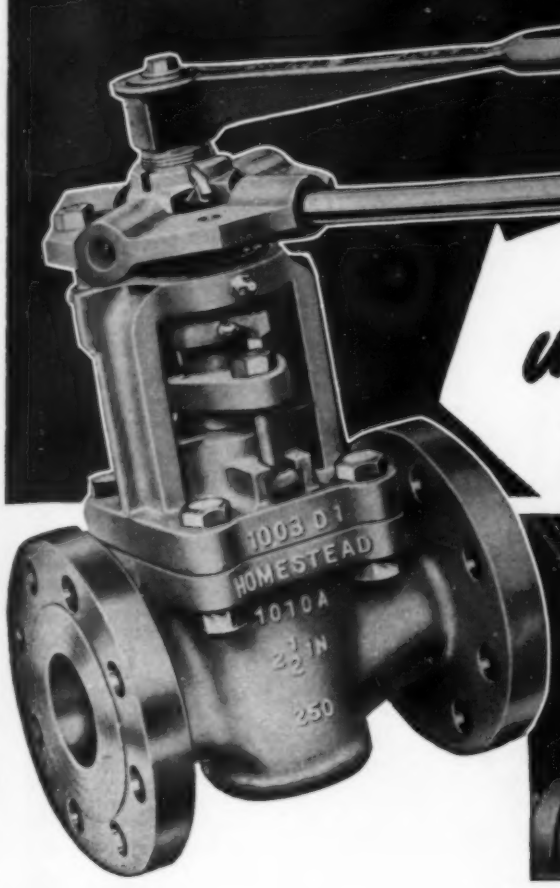
Mathematical chemical investigation of molecules containing phosphorus indicated how the proportion of toxic chemicals in HETP could be increased by minor alterations in the manufacturing process. The same purely theoretical approach can be used also to improve cleaning agents, solvents, and other insecticides made from phosphorus.

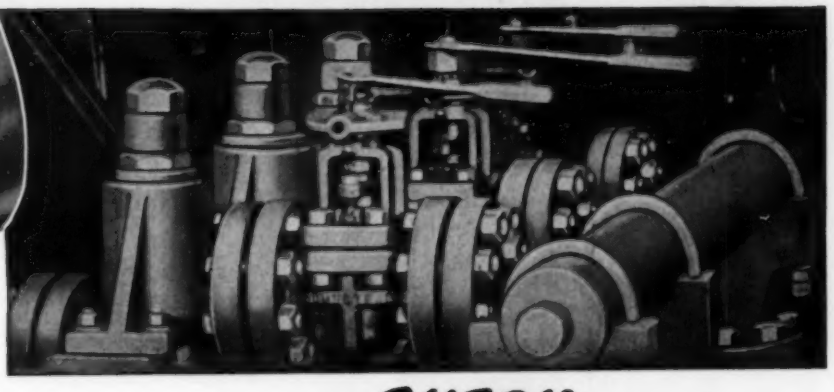
The starting point for the manu-

For Never-Failing STICK-PROOF Operation

in Services Involving Extreme Temperatures, Pressures and Corrosive Fluids

use HOMESTEAD LEVER-SEALD VALVES





For more than 15 years HOMESTEAD LEVER-SEALD VALVES have solved the operating difficulties of hundreds of manufacturers in services where temperature extremes, pressure and the corrosive action of line fluids would cause ordinary valves to stick or "seize."

HOMESTEAD LEVER-SEALD VALVES *never* stick. For built into each valve is a powerful lever and screw device which relieves seating pressure between plug and body just enough to overcome friction and permit *easy turning at all times and under all conditions.*

They operate *faster* too . . . 16 to 28 times faster than screw-stem-type valves, because a QUARTER-TURN *fully opens or closes* them. The QUARTER-TURN principle also makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where many other types of valves could not be operated.

HOMESTEAD LEVER-SEALD VALVES are available in combinations of metals and alloys to meet *your* service requirements. Sizes range from 1½" to 10" for pressures from vacuum to 1500 pounds. For complete details write for Valve Reference Book No. 38. No obligation.

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- **INSTANT STICKPROOF OPERATION. Plug turns freely after seating pressure is relieved by screw lever.**
- **LEAK PROOF. Deep stuffing box and gland prevent leakage.**
- **POSITIVE LEAKLESS SEAL WITHOUT USE OF LUBRICANT is obtained by reapplying full seating pressure with screw lever after opening or closing.**
- **STRAIGHT-LINE FLUID FLOW. No obstructions to cause pressure drop.**
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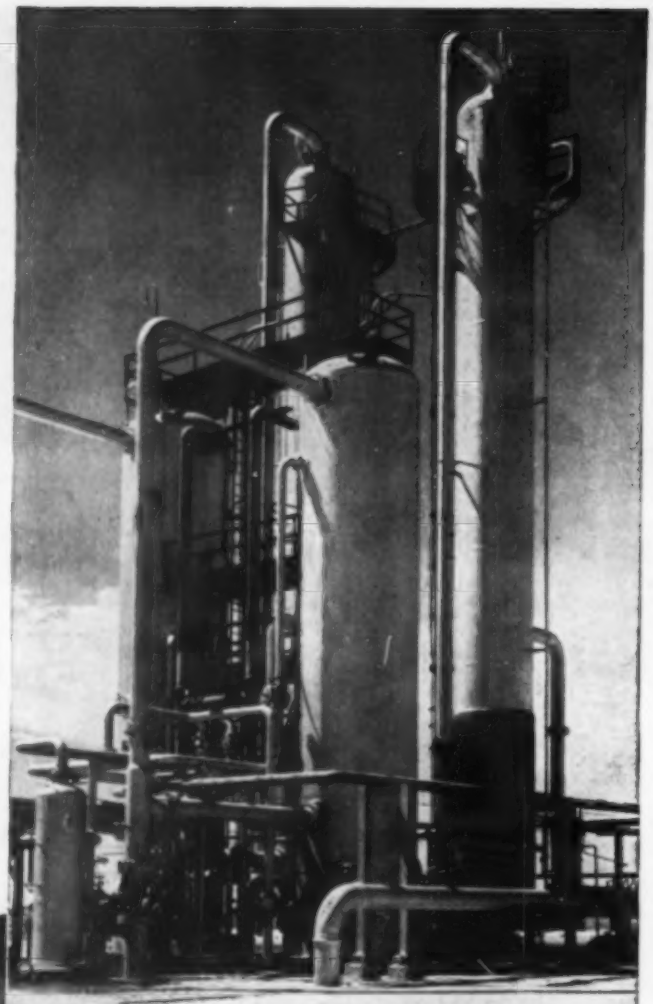

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See Sweets Files, Chemical Engineering Catalog, Refinery Catalog, etc.

facture of many commercially valuable phosphorus compounds, including HETP, is phosphorus pentoxide. This inorganic chemical is built up of molecular units containing four phosphorus atoms and ten oxygen atoms. These are arranged in a definite geometric pattern with respect to each other. The products obtained from this important commodity are visualized by considering theoretically what may happen when other chemical molecules attack the fundamental structural unit of phosphorus pentoxide. Statistical approach to this problem has served to explain the varied nature and the composition of many of the reaction products of this oxide of phosphorus.

While theoretical and fundamental in nature, it is expected that this concept will be useful when applied to the manufacture of many phosphorus compounds used as cleaning agents, insecticides, and solvents. Consideration of the fundamental structural make-up of such molecules should make it possible for chemists and chemical engineers to improve existing production methods.

L. F. Audrieth and O. F. Hill, University of Illinois, before a technical conference of the Chicago Section, American Chemical Society, and American Association for the Advancement of Science, Chicago, Dec. 26, 1947.

What Does AEC Do?

THE WORK of the Atomic Energy Commission falls into four main classes.

In order to produce fissionable materials, it is most important of all to have the necessary source materials. Uranium 235 is obtained as a purified fissionable material by the process of isotope separation. The large industrial installations for this separation are located at Oak Ridge, Tenn. Two methods of separation have been employed: the electromagnetic method, which is now largely in standby condition; and the gas diffusion plant now fully in operation. The production of plutonium is carried out in the large nuclear reactors at Richland, Wash. Plutonium is produced by a nuclear reaction from uranium 238, which constitutes most of the uranium, by the excess neutrons produced in the fission of the uranium 235. It is in the field of the production of fissionable materials and the supporting activities that the commission spends the greater part of its funds. At Hanford, Wash., a major construction program has recently been undertaken. This construction is intended in part to overcome obsolescence and deterioration in the big nuclear reactors which are

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This comprehensive volume describes a complete line of high-pressure equipment—everything from valves and fittings to complete pilot plants—a valuable guide for selecting proper equipment for high-pressure research and production.

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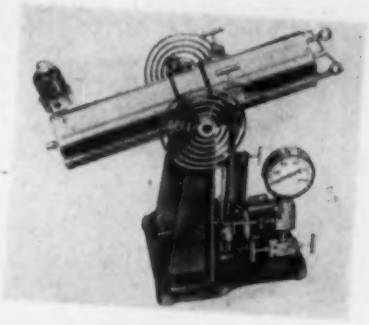

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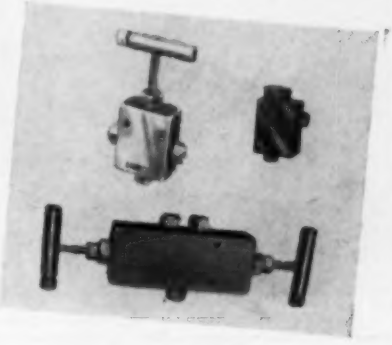

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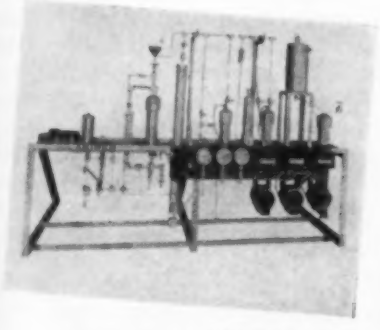
Needle valves (straightway, angle, and cross), and combination inlet and bleeder valves, for pressures up to 100,000 psi. Check valves for pressures up to 25,000 psi. Also others.



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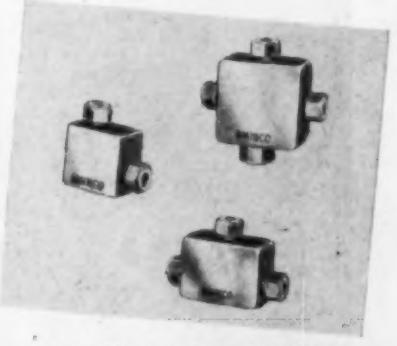

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Tubing made of stainless steel and other alloys for pressures up to 100,000 psi.

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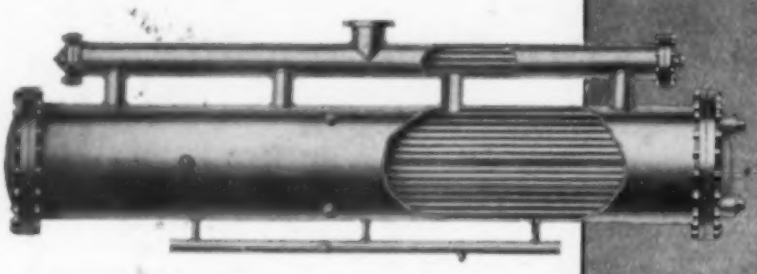

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Can be supplied with stand or legs, covers, level gauges, etc.

Capacities:
10 to 1000 gallons

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located there, and in part to take advantage of new process improvements.

The work on the development and production of atomic weapons is carried out at Los Alamos, N. M. Since it makes little sense to carry on the development of new weapons without testing them, the commission has recently established an atomic proving ground at Eniwetok in the Pacific.

There are many promising possibilities in the development of nuclear reactors which will better utilize the energy produced in the fission process and also the source materials which are consumed. With a reactor designed to operate at higher temperature, it should be possible to produce high-pressure steam and then by conventional methods electrical energy. Since such a reactor, particularly if it utilizes enriched materials, need not be excessively large or heavy, it could possibly be used as a source of power for ship propulsion. Reactor development also includes the most efficient use of the raw materials, and here there is a particularly enticing possibility. It may be possible with full utilization of the neutrons emitted in the fission process, to produce more than one new atom of fissionable material for each atom of fissionable material which is destroyed. Work is now under way to determine whether such a reactor can actually be built. If it can, it will open the possibility of consuming fissionable material to produce energy and neutrons and at the same time producing more fissionable material than has been destroyed.

Developments on the Atomic Energy Project have many times been slowed down for lack of fundamental scientific information. Of particular importance is our lack of knowledge of the nucleus itself. Today, after many years of concentrated effort on nuclear physics and after a considerable nuclear technology has been built up, we are little further along in our understanding of fundamental nuclear forces than we were ten years ago. To continue to build this technology upon such a small understanding of the origin of the nuclear forces is, indeed, to court disaster.

R. F. Bacher, Atomic Energy Commission, before Industrial Research Institute, Rye, N. Y., Feb. 4-6 1948.

Why the Chemical Industry Is Pre-Eminent

THE CHEMICAL industry maintains a pre-eminent position because it combines most of the elements considered desirable in the mind of an

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This new "B-P" machine was developed specifically for the intensive mixing and dispersing of Plastics and similar products; in fact, it is the first piece of equipment ever produced for this specific operation.

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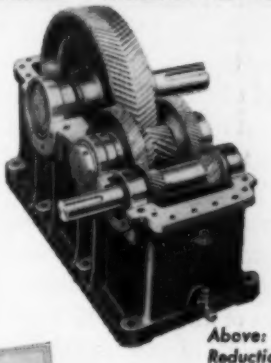
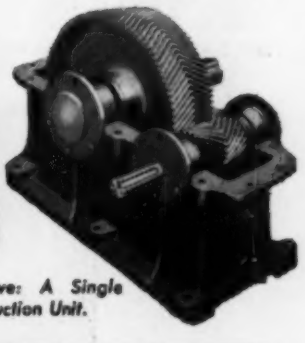
Thousands of Philadelphia Herringbone Units are in daily use throughout the world—Single, Double, and Triple Reduction types—in most every conceivable industry.

We make all types of Herringbone Gears: Sykes (continuous tooth type); Staggered Tooth, and Separated Tooth. However, the Sykes (continuous tooth) type is generally favored, because it gives: (1) greater tooth strength (2) increased bearing surface (3) extra load-carrying capacity. The Sykes type is highly recommended for heavy duty drives, *where continuous service is required—where vibration and noise are objectionable—where very high efficiency of operation is desired, and where high reduction must be obtained in a single gear train.* Our equipment will produce Continuous Tooth Herringbone Gears up to 60" dia.; 18" face—and Separated Tooth Herringbone Gears up to 160" dia.; 48" face.



Above: A Double Reduction Unit.

Write for our large, informative and interesting catalog, H-39, which gives complete engineering data on Philadelphia Single, Double, and Triple Reduction Herringbone Speed Reducers, and please use your Business Letterhead.



Above: A Single Reduction Unit.

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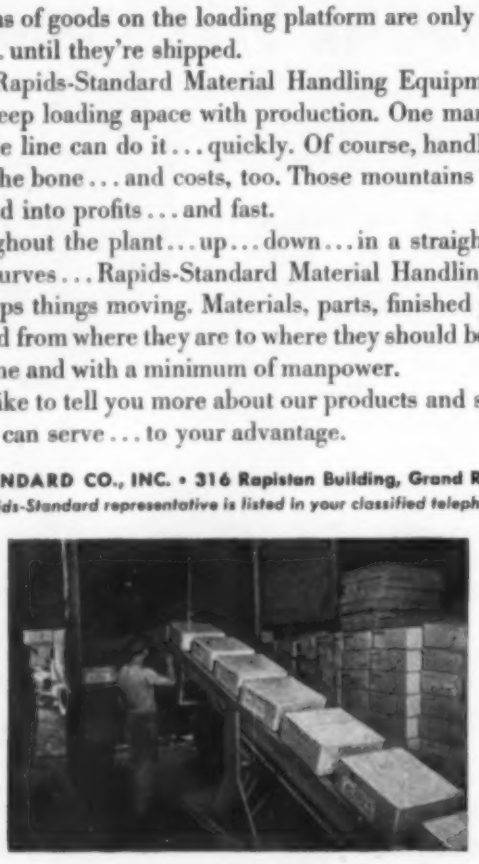

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MATERIAL HANDLING EQUIPMENT

investment manager. The industry is well managed, has a favorable long-term-growth trend of sales and earnings, has a diversification of markets unequalled by any industry in the country, and has a high degree of financial strength. It is more stable than most industries in cyclical fluctuations of business, has a favorable internal competitive position and a strong competitive position in relation to other industries competing in the same markets, has a high degree of flexibility in operations because of low labor costs and rapid technological progress enabling it to reduce costs and prices, and, last but not least, has favorable labor and public relations with the government and the public.

A strong industry must rely on research. Chemical research in the chemical industry has doubled since before the war. It is spending a larger proportion of each sales dollar for research than any other industry.

Two important major trends that give the chemical industry added strength are the trend toward the manufacture of more and more semi-finished and finished products closer to the ultimate consumer and away from the basic chemical raw materials.

It has already been noted that by far the most promising field of investment is in organic chemicals because of their relatively much greater growth than that of inorganic chemicals. Those companies that are vitally interested in plastics, synthetic resins, synthetic fibers, agricultural chemicals, including insecticides, fungicides and herbicides, and antibiotics appear to have the most promising outlook. This does not mean that companies producing inorganic chemicals or organic chemicals not included in these categories may not do very well. The investment manager however, recognizes that in the field of organic chemistry many of the various product developments are becoming industries in themselves and that this is particularly true in such fields as rubber, synthetic fibers for textiles, and in the field of detergents.

The chemical industry is engaged in the greatest expansion program of its history. This is the result of the very limited expansion that occurred during the war and because of the new markets and products that have been and are being developed since the war. Many of the products stem from research work interrupted by the war, and many from the research done during and since the war. Anyone concerned with the investment of funds in the industry must necessarily attempt to analyze this expansion pro-

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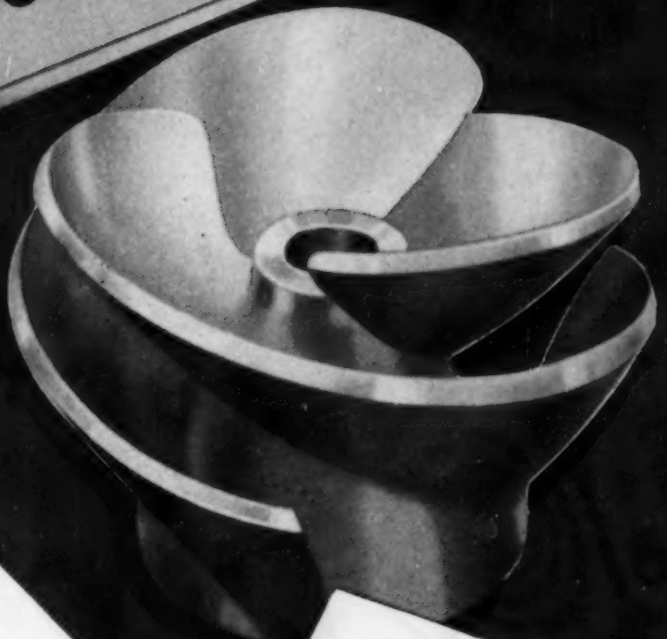

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This unusual casting, produced for the FOSTER WHEELER CORPORATION, was cast in both Stainless Steel and Monel and is the impeller for a 42" mixed flow condenser circulating pump having a capacity of 28,750 gallons per minute. The casting illustrated is a product of Cooper's 25 years of Stainless Steel "know-how" and indicates the flexibility of Cooper facilities to produce Stainless Steel castings from one ounce to two tons in weight.

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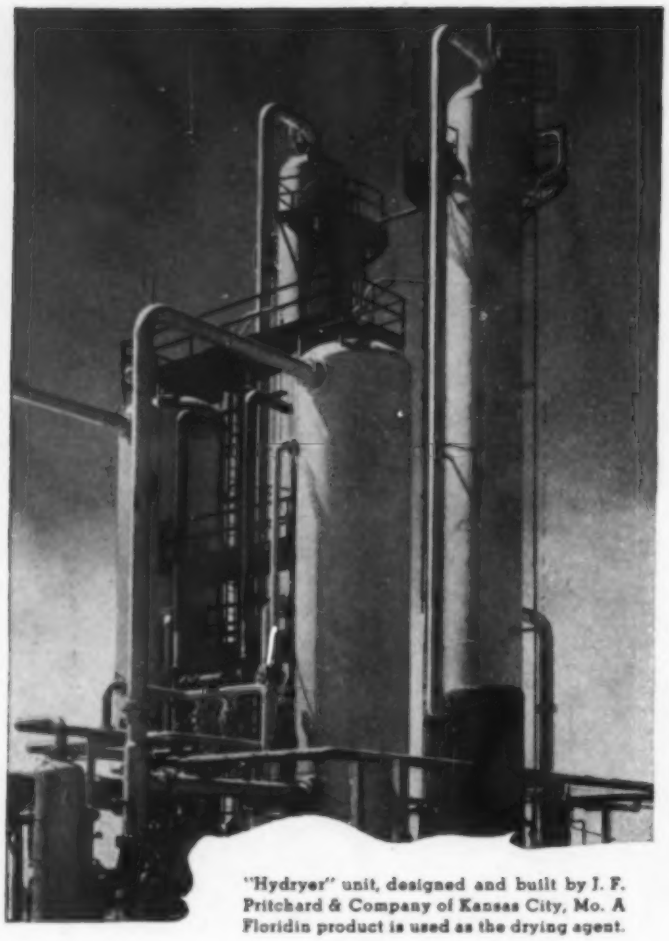

"Hydryer" unit, designed and built by J. F. Pritchard & Company of Kansas City, Mo. A Floridin product is used as the drying agent.

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gram and determine its effect upon the financial and operating position of the chemical companies.

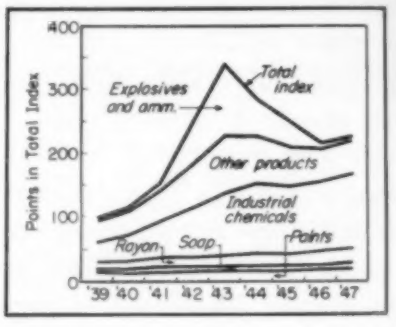
R. D. Naess, Naess & Cummings, before Commercial Chemical Development Association, New York, March 10, 1948.

Federal Reserve's Index of Chemical Production

THE index of total industrial production is compiled to represent all manufacturing and mining and thus covers about a fourth of gross national product. It is a measure of physical volume rather than of dollar volume. It is based on indexes for 18 major groups, which in turn are based on indexes for their components.

The chemical index, designed to represent all industries included in the 1939 census group of chemicals and allied products, is now about as complex as the total index was when it was first published in 1927. Chemicals production represents only about 8½ percent of the total.

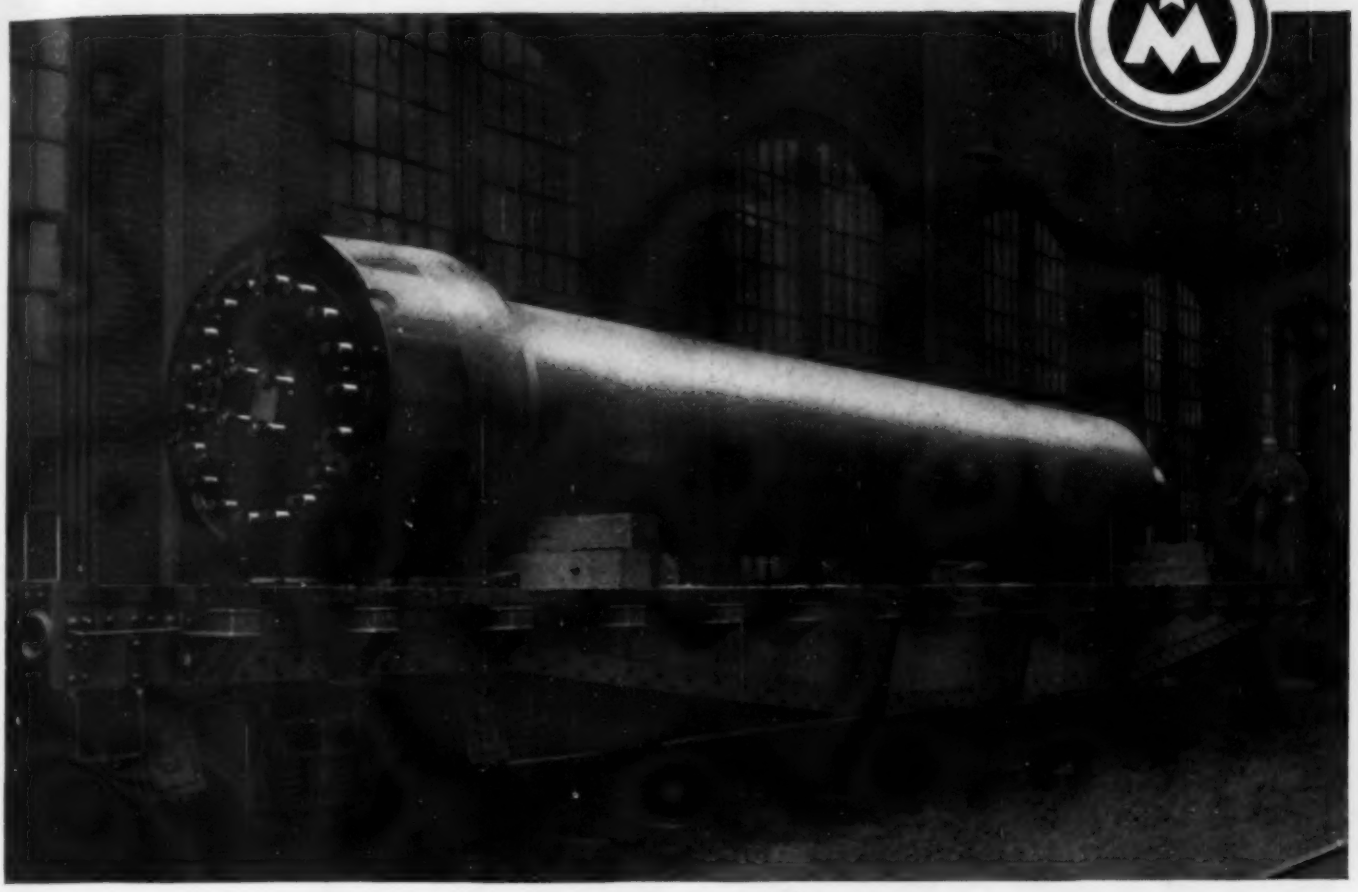
The board's first index of production in the chemicals and allied products group was compiled in 1940 mainly to improve the accuracy of the index of industrial production. Prior



Composition of the Federal Reserve Board chemical production index. 1939 = 100

to 1940 chemicals were not included in the index. In the 1940 revision a single index for the whole chemicals group was computed. Monthly figures were interpolated for the past and carried forward into the future by use of reported man hours, adjusted for estimated changes in output per reported man hour. The current estimates made proved considerably too low and in 1943 it was decided to change the method.

The new plan provided for computation of annual, and in some cases quarterly, physical volume indexes so that current estimated levels could be revised without waiting for a new Census. Also, separate current estimates were developed for paints, soaps, rayon, industrial chemicals, explosives and ammunition, and all



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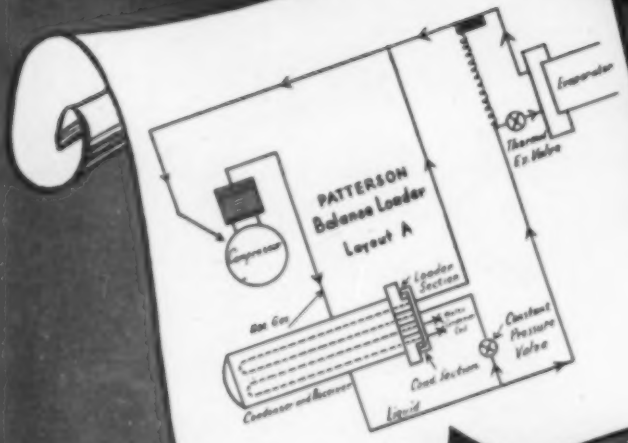

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In writing for further details, give information on capacity and evaporator temperature desired and a description of the system. The Patterson Balance-Loader can be installed in existing systems.

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other products combined; and also for several subgroups.

The group index, however, has approximated the facts fairly closely and has improved the accuracy of the index of industrial production.

The procedure for combining various series has been to use Census figures on value added by manufacture in 1939 as far as possible and otherwise to use value of product. One special point is that output of materials does not provide a good measure of output of finished products or of the manufacturing process (which is really what is supposed to be measured) when materials are being subjected to an increasing amount of fabrication. At the same time care must be taken to avoid giving undue weight to materials which appear several times in the value of product at successive stages of production.

The results of the board's work are shown in part in the attached chart of annual data. The top line shows the index for the whole chemicals and allied products group, with 1939 as 100. The composition of this total is shown by the areas below.

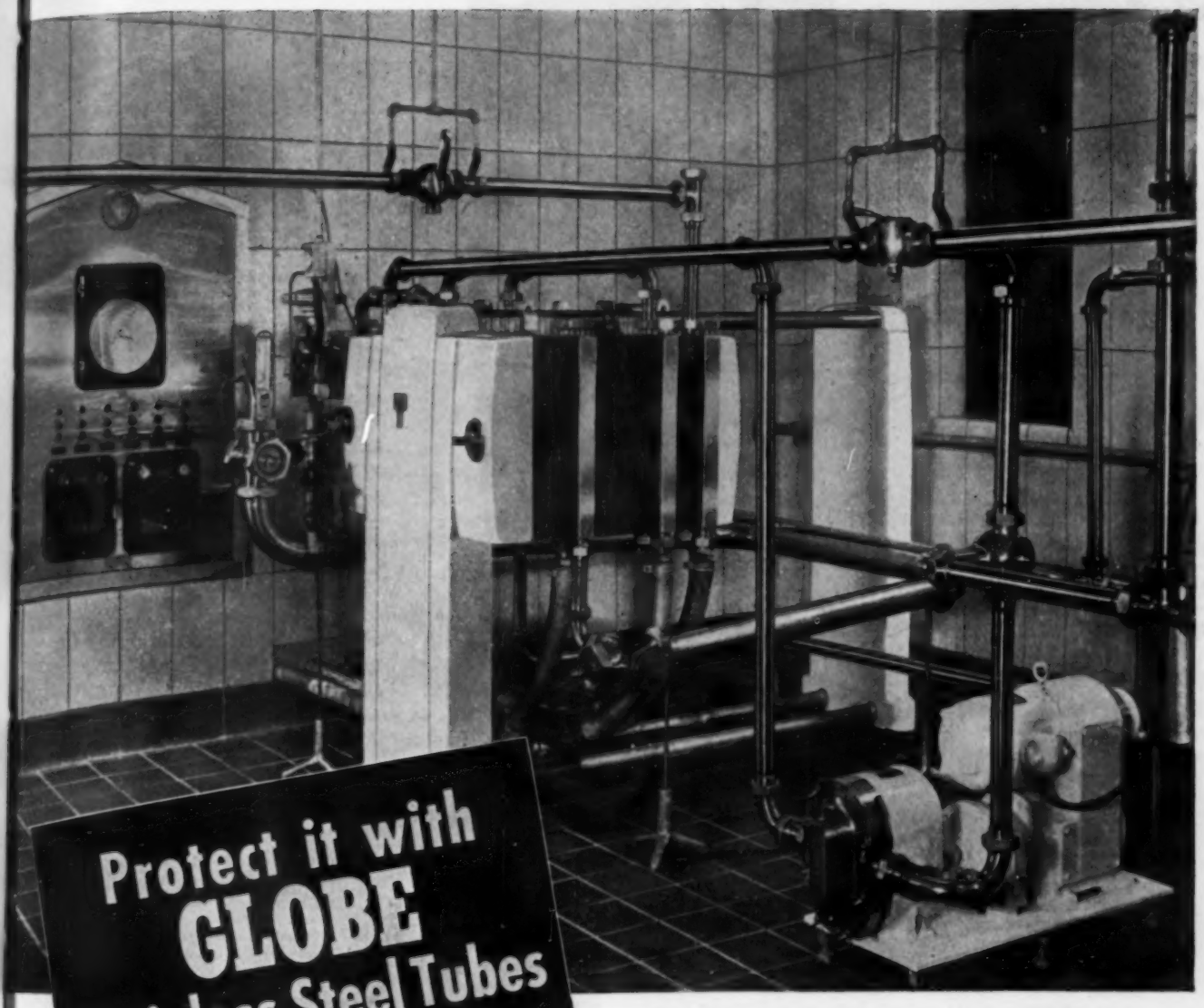
F. R. Garfield, Board of Governors of the Federal Reserve System, before Chemical Market Research Association, New York, Jan. 22, 1948.

Gearing Development To Research

A COMMERCIAL development group must be properly geared and not be out of mesh with the rest of the organization. Probably the most serious tendency to move out of step with a planned program is the temptation to push the commercial introduction of a new product faster than the company's research and production programs justify or to claim for the new product things which have been indicated but have not yet been proved. This is one important consideration in gearing commercial development not only to research but also to production, and the gearing mechanism should provide some means by which the commercial development organization can keep its progress within the limits justified by the progress of research and production.

Research and commercial development each has a definite field of activity and each should be manned by people with enough intelligence to do the proper things in their particular field if they have a full understanding of what is occurring in the other. This full understanding of each other's problems cannot be gained by any formal system of reports but it must be based upon frequent personal

SANITATION . . .



To protect purity of product, to avoid contamination, to reduce corrosion and to gain maximum, long-range economy—use Globe Stainless Steel Tubes.

Food and process manufacturers prefer the security, sanitation, and safety of Globe Stainless Steel Tubes for many reasons:

— it is tubing that is chemically and physically inert to food and process products — is not itself affected nor does it affect them.

— special polishing equipment is used to produce the perfect inside and outside polished finishes that are so desirable in the food, dairy and other industries.

— the normal flow of liquids and cleaning compounds tends to keep Globe polished tubing naturally clean.

— no dependence on thin coatings; the entire wall thickness is stainless steel. Daily scouring only improves the polish and contributes to sanitation.

The Globe Steel Tubes Co. is equipped to bend, polish, expand swage, coil, and form stainless steel tubes. Globe stainless tubes can be furnished round, oval, square, rectangular, hexagonal, octagonal, streamline and other shapes. We will gladly cooperate with you on any tube problems which you may have, and will make recommendations as to the best analysis suited, based on previous experience and tests.

Write for Bulletin No. 115A and complete information on Globe Seamless Stainless Steel Tubes and Gloweld Welded Stainless Steel Tubes.

GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

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HERCULES Aero (RUBBER CUSHIONED) CARBOY BOXES

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13 GALS.

Specifications:

SIZE: 17½"x17½"x22"

WEIGHT: Approx. 45 lbs. without bottle.

CARBOY: 13 gallons.

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Other Carboys available in 5 and 6½ gal. sizes.

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Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

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contacts by men at comparable levels of responsibility all the way down through both organizations. It must be based upon a willingness on both sides to present the reasons and evidence behind each decision and a sincere desire not only to explain one's own position but also to understand the position of the man in the other organization.

C. F. Rassweiler, Johns-Manville Corp., before Commercial Chemical Development Association, New York, March 10, 1948.

Why It Takes Longer

THE TIME required to build an industrial plant today is about twice as long as it used to be back in the 1930's or prior thereto. This for several reasons:

Throughout all the country nearly all building operations are completely unionized whereas 15 or 20 years ago this was true only in major metropolitan centers.

The working day varies from 6 to 7 hours in most trades whereas it used to be possible and was generally customary to work men 9 or 10 hours if speed was a factor.

Production per man hour in most building operations is not much over half what it used to be if in many trades it is that. Furthermore in many areas there is a real shortage of building mechanics so that sometimes it is difficult to adequately man a job.

Buildings built today are generally more complicated and more elaborate than those built in the periods between World War I and World War II.

Materials—especially steel and electrical installations—take considerably longer to get than formerly.

J. P. H. Perry, Turner Construction Co., before Chemical Market Research Association, New York, March 12, 1948.

A New Crystal Ball

ONE of the least glamorous but most important duties of the engineering department in a chemical plant is the control of repair and maintenance costs. It has seemed that there should be some common denominator of plant activity which would permit comparison through periods of high and low production and in spite of the great variety of liquids, pastes and powders manufactured.

Among the various control methods considered previously in studying this problem, one was to relate repair cost to plant investment. Unfortunately, such a ratio gave no help in deciding what might be considered a reasonable cost, but rather, seemed

Go Lead for Acid Equipment

Whenever acid corrosion is further complicated by extreme conditions of pressure, temperature or other physical problems . . . go for equipment that can handle these extra jobs. Go for National Lead's "Homogeneous" Lead-lined or Lead-covered Equipment.

You get all of lead's many advantages, plus National Lead's permanent "Homogeneous" bonding.

Here are three reasons why "Homogeneous" equipment makes acid-handling less of a problem.

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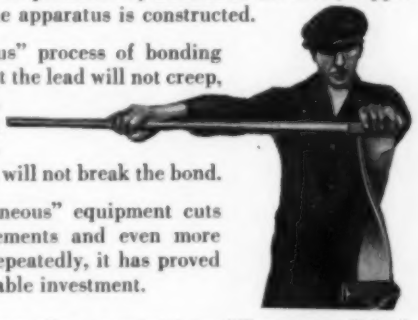

The "Homogeneous" process of bonding is your assurance that the lead will not creep, buckle, or separate. Shock, vibration, full vacuum, high temperature or pressure, will not break the bond.

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2 Endurance at High Temperatures! There's no tin or tin-lead solder used in the bonding of "Homogeneous" equipment. You can use this equipment safely at temperatures closely approaching the melting point of lead itself (621°F.).

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Endurance at high temperatures isn't the whole story either! The "Homogeneous" bond holds fast *even when subjected to rapid changes in temperature.*

Most of the "Homogeneous" processing equipment produced by National Lead is designed for service at elevated temperatures. This includes not only lead-lined tanks, autoclaves and the like, but also lead-covered agitators, propellers and mixing devices of many types.

3 Designed to Order! As acid-handling problems differ, equipment must be designed for each given set of conditions. Every piece of National Lead's "Homogeneous" Lead-lined or Lead-covered Equipment is individually fabricated to your specifications.

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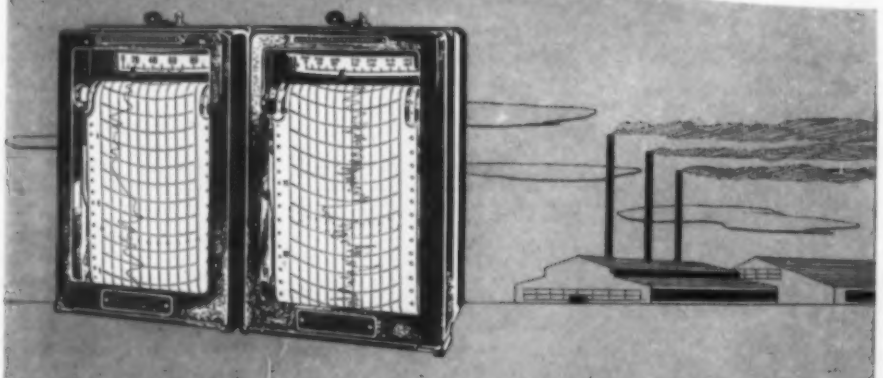

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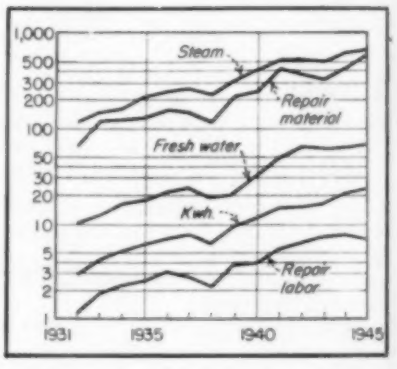
to confirm the claims that matters were going from bad to worse.

Another attack on the problem was to compare repair labor with repair material. The ratio of dollars of repair labor per hundred dollars of repair material was calculated and plotted. From a curve it was more than difficult to draw any conclusion about whether the plant in question was doing well or poorly.

A third control system which was suggested was to calculate the cost of repairs per ton of production, making suitable corrections for changing rates of pay and for changing costs of materials. In some plants, this method was found to be fairly satisfactory, but in others, it gave enormous variations from year to year. Also, it has the disadvantage of requiring corrections based upon an index which had to be estimated.

During the course of these studies, we plotted practically all data available on the plant records. Gradually, a pattern evolved and it became evident that there was remarkably close agreement in the slopes (on semi-log paper) of such things as pounds of sulphuric acid used, pounds of steam and kilowatt hours of electricity consumed, cubic feet of water pumped, dollars of repair material used and man hours of repair labor paid.



Annual consumption curves for materials, services and labor showed similar trends

From a study of curves such as these, it seemed evident that either steam or electric power consumption might be used as the basis for comparison. However, the former could be affected by seasonal variations in the heating load, whereas the latter depended only upon the normal activities of the plant. Accordingly, the kilowatt hour of electricity was taken as the common denominator of plant activity.

When the man hours of repair labor used each year in the plant were divided by the electric power consumed in those years, it was found that the ratio was remarkably con-

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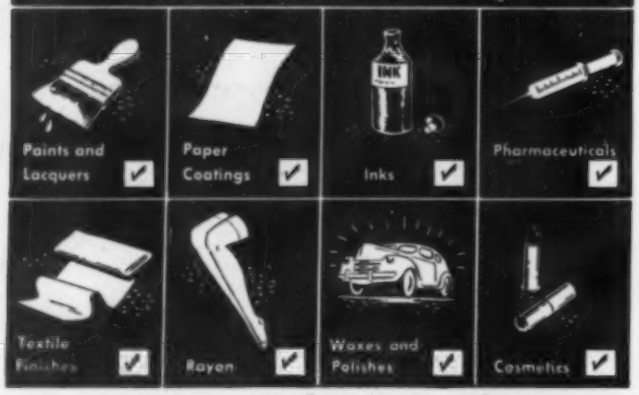

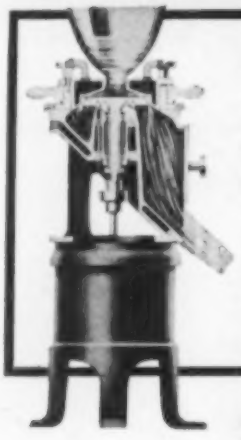

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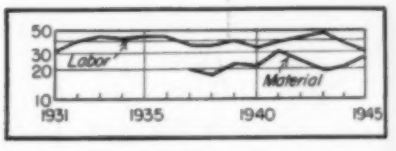
stant. That is, the "Man Hours of Repair Labor per Thousand Kilowatt Hours" were found to average 38.7, with an average deviation from the mean of ± 10 percent. The 15-yr. period covered by the study includes a "depression," a "recession," some reasonably good years of more or less normal business, the years in which war in Europe was going on, and, finally, the years in which the United States was involved in the war. It ends with the close of the war in 1945. Inasmuch as the ratio of repair labor hours to electrical energy consumed remained reasonably constant through such changes in almost everything else, it seemed a good basis for a study of repair costs so far as labor was concerned.

To see whether this ratio was peculiar to one company, we invited the cooperation of other companies. It was possible to plot data on repair labor vs. kilowatt hours for eleven plants in the chemical industry, varying widely in size and in the type of products manufactured. In all cases, the data seemed to justify the conclusion that there was a remarkable consistency in the repair labor index for each plant, even though the plant activity, as measured by kilowatt hours, increased in some cases as much as ten times during the period studied.



Repair labor index and repair material index for a typical plant; expressed as man hours and dollars per 1,000 kwh.

Just as the repair labor hours for a period of years, plotted on semilog paper, showed a slope similar to that of kilowatt hours consumed, so did the cost of repair material in dollars. Accordingly, a Repair Material Index was determined for each year by dividing the cost of material by energy consumed and expressing the result as "Dollars of Repair Material per Thousand Kilowatt Hours." For the plant whose repair labor index averaged 38.7, the repair material index averaged $23 with an average deviation from the mean of ± 11 percent.

Thus far, it has been shown that repair labor hours and repair material costs are reasonably constant per unit of plant activity. However the pay per man hour is anything but constant.

A formula for budgeting repair

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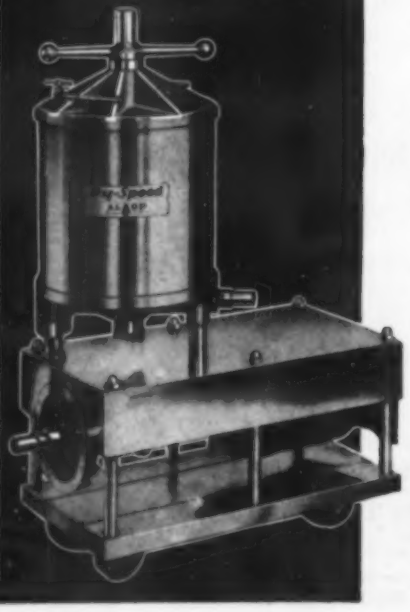

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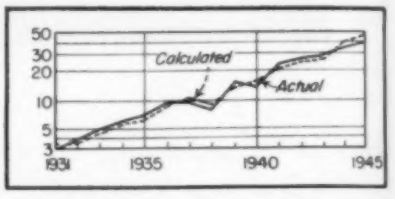
costs should include two constants (repair labor index and repair material index) and two variables (pay with overhead per man hour and kilowatt hours consumed).

Such a formula may be written in the following form:

$$c = x\,(a + by)$$

Where c = cost in dollars per year; x = kwh. per year (1,000); y = cost in dollars per man hour with overhead; a = repair material index, as dollars per 1,000 kwh.; and b = repair labor index as man hours per 1,000 kwh.

To illustrate the applicability of this method, the "theoretical repair cost" according to this formula was calculated for one plant from its records for 15 years and the actual repair cost was plotted in comparison with the theoretical. For the whole period, the actual costs average 101.7 percent of theory, with an average deviation from the mean of ± 8.5 percent.



Actual repair costs compared with those obtained from the repair cost formula; the units are consistent but arbitrary

The repair cost formula may be used in several ways. It provides a mathematical standard of measurement of repair cost against a background of plant history. Thus, the cost for the current year may be compared with the "ten year average" or with "last year," even though production, rates of pay, and other factors have varied to a great degree. Also, the plant engineer can set up his repair budget for the year by selecting what he considers a reasonable repair labor index and repair material index and can have a monthly comparison of actual vs. budgeted cost (in total dollars and by index numbers). He can observe unusual trends up or down in either labor or material and can take steps to investigate them.

Not only does the repair cost formula apply to entire plants, but it may be used for individual departments or sections of the plant where proper data are available. In this way, it is possible to determine for each department its own repair labor index and its own repair material index so that the effect of any individual supervisor's efforts in trying to reduce

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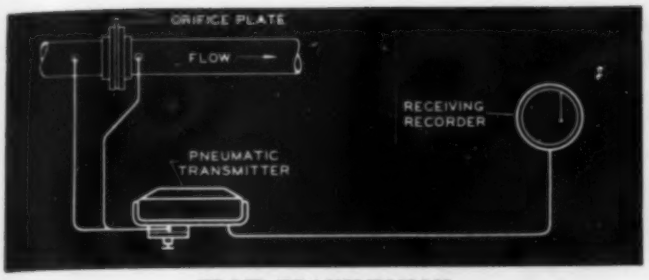

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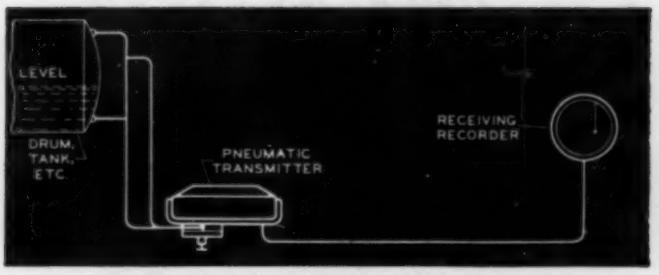

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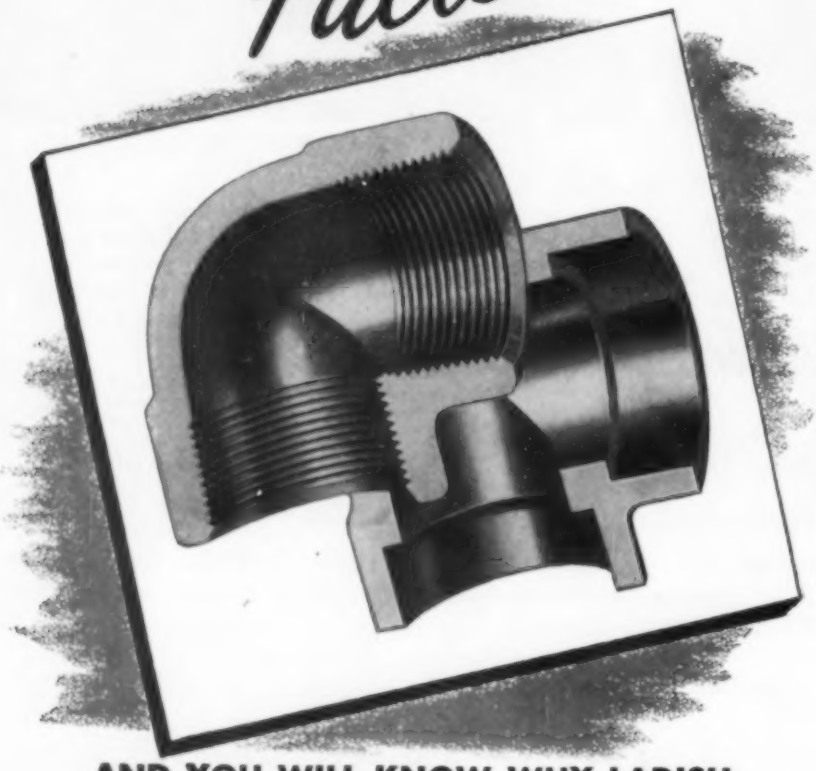

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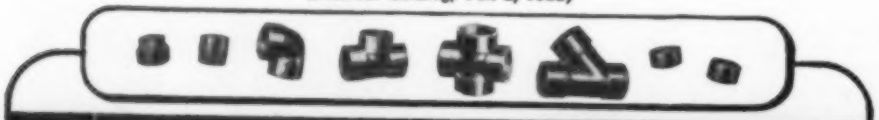

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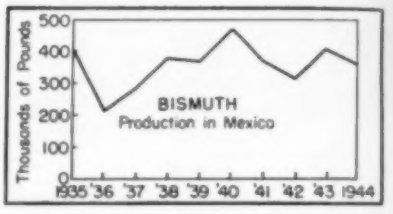
repair costs may be evaluated and shown as percent gain or loss against the standard set for him.

D. E. Pierce, General Aniline and Film Corp., before American Institute of Chemical Engineers, New Orleans, Feb. 16, 1948.

FOREIGN LITERATURE ABSTRACTS

Mexican Production of Bismuth

ALTHOUGH Mexico is not a large-scale producer of bismuth, its production of this metal during the period of the war was more than one and a half million pounds. All the Mexican bismuth comes from the American Smelting Co. located in Monterrey, the



"Pittsburgh" of Mexico. The bismuth deposits occur chiefly in the states of Guanajuato, Durango, Chihuahua, San Luis Potosi, Queretaro and Mexico. In the years before the war Mexico occupied fourth place among the world's producers of bismuth, the United States taking first place, Peru second and Canada third. During the period of 1935-1939 Mexico produced an annual average of 384,700 lb. The attached graph shows Mexico's prewar and wartime production of bismuth.

Digest from "Mexican Victory Minerals" by Eugenio Yaita, *Industria Minera* No. 66, 48-53, 1947. (Published in Argentina.)

Isomerization of Alkyl Cyclopentanes

IT WAS found in previous work that cyclopentane homologs are isomerized into methylated derivatives of cyclohexane when heated to boiling in the presence of aluminum chloride. Further experiments were carried out to determine whether this reaction occurs without an external supply of heat. After the aluminum chloride was added to the hydrocarbon a vigorous reaction began spontaneously and was accompanied by a rise in temperature ranging from 32 to 50 deg. Under these conditions ethylcyclopentane was isomerized to methylcyclohexane to the extent of 97.8 percent, *n*-propyl-

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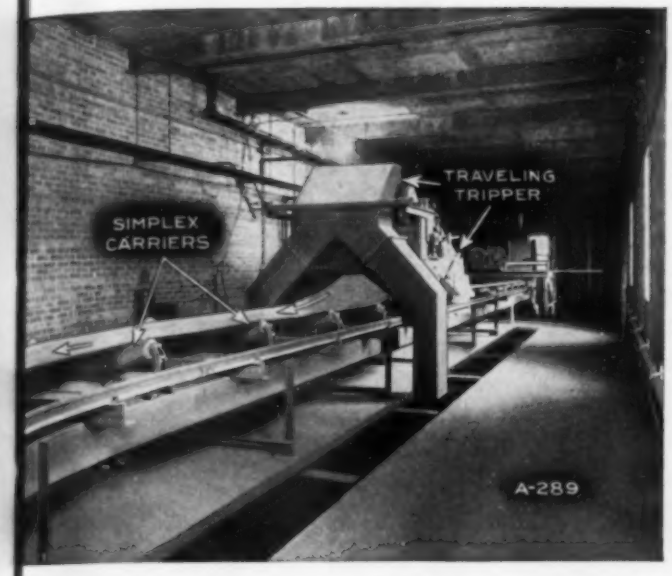

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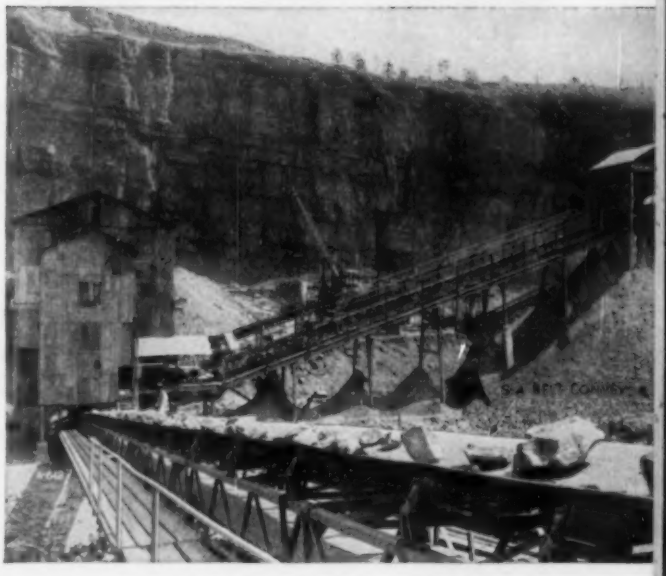

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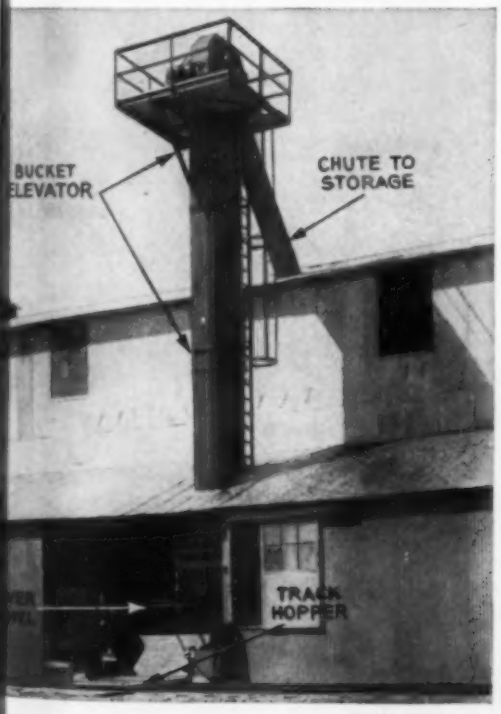

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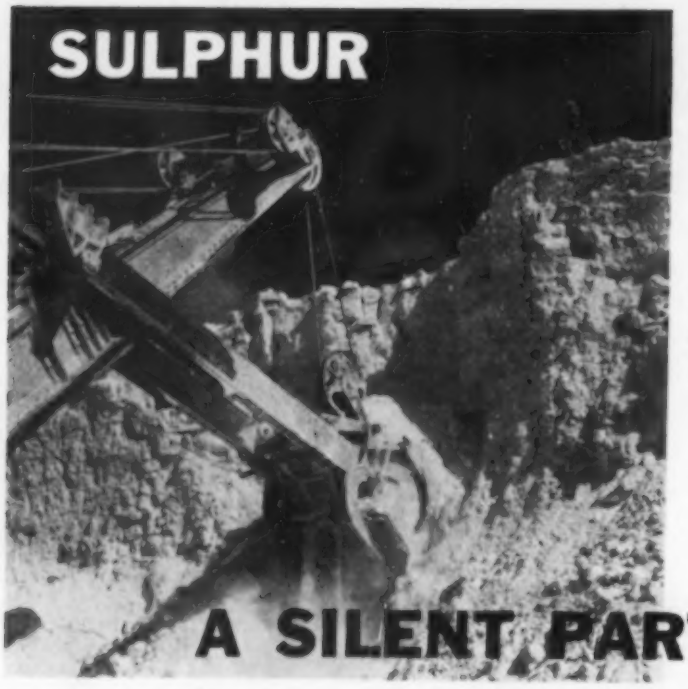

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THIS valued "silent partner" is Sulphur, which gives its unique chemical properties to a multitude of industrial processes. For instance, Sulphur is used in the production of pulp and paper, rubber, steel, petroleum products, rayon, industrial chemicals and fertilizer. These are only a few of the industries which need the help of Sulphur. Sulphur, too, is a versatile partner for the industrial chemist. In the constant search for new products and new methods, Sulphuric Acid is the chemist's most useful tool.

INDUSTRIES, old and established, new and modern, those still in the test tube stage, all owe much to this hard-working "silent partner," Sulphur.

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cyclopentane to dimethylcyclohexane to the extent of 86.6 percent, and n-butylcyclopentane to trimethylcyclohexane to the extent of 68.4 percent. The investigation again confirmed the ability of aluminum chloride to cause isomerization of cyclopentane homologs to cyclohexane derivatives. The reaction is practically irreversible.

Digest from "Isomerization of Polymethylene Hydrocarbons under the Action of Aluminum Chloride. XII. Optimum Conditions of Isomerization of Alkyl Cyclopentanes" by M. B. Turova-Polyak, N. P. Egorova and E. N. Petrova, *Zhurnal Obshchei Khimii* 16, 825-828, 1946. (Published in Russia.)

Gas Treatment of Chrome Catalyst

INFLUENCE of gas treatment (oxygen, nitrogen or hydrogen) on the activity of a 20 percent Cr_2O_3–80 percent Al_2O_3 catalyst in the process of cyclohexane dehydrogenation has been studied. The catalytic activity of the catalyst is increased by heating it from 450 to 650 deg. in air, but no such effect is observed when the same catalyst is heated in a stream of nitrogen. A marked decrease in the catalyst's activity is caused by the rise of temperature from 450 to 550 deg. when the catalyst is reduced with hydrogen. The increase in its activity caused by air treatment at different temperatures persists after its reduction with hydrogen.

Digest from "Influence of Gas Treatment on the Activity of a Chrome Catalyst" by G. N. Maslianshy and N. R. Bursian, *Zhurnal Obshchei Khimii* 17, No. 2, 208-212, 1947. (Published in Russia.)

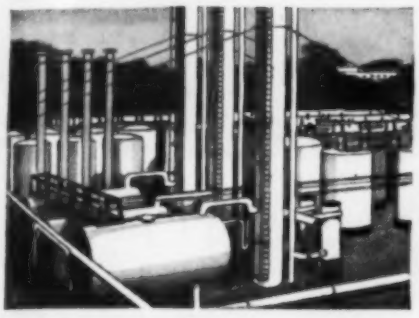
Action of Benzoyl Peroxide on Rubber

BENZOYL peroxide affects solutions of natural rubber in various ways, depending on conditions of operation. In the absence of oxygen it vulcanizes the rubber and the results depend on such factors as temperature, solvent, amount of benzoyl peroxide, concentration and degree of degradation of rubber. In the presence of oxygen vulcanization (gelification) does not occur and degradation of the rubber is observed. If the reaction mixture contains less benzoyl peroxide, for example 1 percent instead of the 8 percent used in the experiments, there will always be enough oxygen present to prevent gelification, even if the apparatus is purged with nitrogen. The degradation of the rubber is less pronounced, however. Apparently, the less benzoyl peroxide there is in action, the smaller quantity of oxygen is capable of preventing gelification.

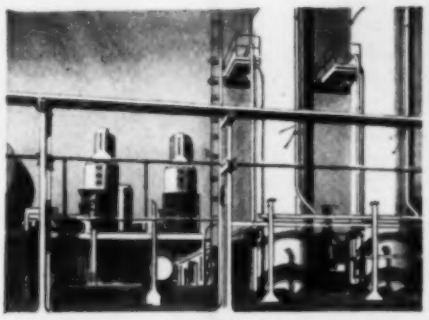
Digest from "Action of Benzoyl Peroxide on Natural Rubber in Solution" by Patrice Compagnon and Andre Delalande, *Revue Generale du Caoutchouc* 24, No. 1, 4-7, 1947. (Published in France.)

To Men with Tough Corrosion Problems

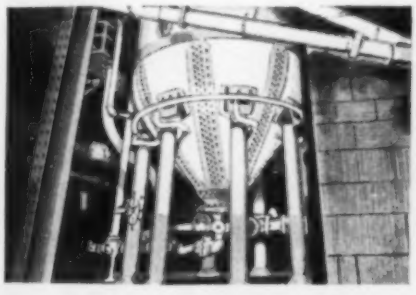
Read these actual case histories of how UCILON Protective Coatings licked tough corrosion problems . . . where other coatings failed!



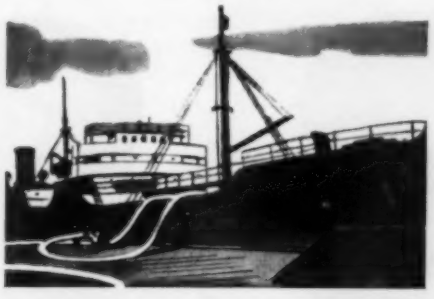
1. A CHEMICAL PROCESS PLANT always had trouble protecting pipelines exposed to atmosphere laden with caustic fumes. No former coating lasted even 6 months. But Ucilon 400 was still going strong *22 months* after application!



2. A LARGE OIL COMPANY applied Ucilon 400 where equipment needed protection from acid and caustic spillage. Corrosion was checked. They report Ucilon standing up where all other coatings tried had failed.



3. A PAPER MILL tried Ucilon 400 on a pulp chute that had required excessive maintenance under constant motion of pulp, soda ash and water at 140°F. Even with fewer coats, Ucilon lasted *3 times* longer than former coatings!



4. A TANKER had Ucilon-coated panels in the hold which carried 100-octane gas, diesel oil, kerosine, salt water ballast. The Ucilon coatings were still good *after 10 months!* No previous coating had survived even one cargo.

UCILON* 400

Ucilon 400 is a flexible, glossy, air-drying coating for metal, concrete and wood. It is applied by brushing or spraying. When solvents evaporate, a tough "plastic" film is formed. Ucilon 400 provides exceptional resistance to acids, alkalies, alcohols, oils and greases, salts, water, cleaning compounds, oxidizing agents.

OTHER UCILON COATINGS

Ucilon 1601—a ready-mixed, extra-bright aluminum paint with exceptional outdoor resistance. It stays bright under prolonged exposure, withstands elevated temperatures.

•

Ucilon 1501—a very hard, chip-resistant baking coating which resists chemical attack at temperatures too high for Ucilon 400.

SEND FOR THIS BULLETIN *which gives more details on various Ucilon coatings and their properties.*

It's the same way in other industries. These four cases are typical of what many users tell us—that Ucilon 400 resists *more* corrosives for *longer* periods than any other coating they ever tried! Why put off the real solution to *your* corrosion troubles? Even a trial of a few gallons will demonstrate how Ucilon 400 resists severe service conditions—and convince you it can end excessive maintenance expense. If you will give us the details of your problem, we'll send specific recommendations for the application. Write today.

* *Trade Mark Reg. U. S. Pat. Off.*

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UNICHROME products of UNITED CHROMIUM, INCORPORATED

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The RIGHT INSULATION, correctly applied, NEVER GROWS OLD

ENGINEERING: In planning your insulation job, first call in an experienced insulation engineer. Johns-Manville . . . Insulation Headquarters for more than 75 years . . . maintains a staff of insulation experts. Each man knows how to take the guesswork out of your job . . . make it "*right* the *first* time."

RIGHT INSULATION: Any insulation will save money —but only the *right* one will save the most for the longest period of time. J-M 85% Magnesia is the most widely used of all industrial insulating materials . . . and one of a wide range of J-M insulations for every service and temperature.

CORRECT APPLICATION: No insulation is better than the man who installs it. J-M Insulation Applicators are industry's first choice for completely efficient jobs because: (1) They are trained in all phases of insulation application; (2) They employ skilled mechanics and up-to-date application methods. You can rely on them for thorough, dependable and speedy workmanship.

35 YEARS YOUNG! J-M 85% Magnesia was applied to pipes of the Eclipse Mill Company, Everett, Washington, back in 1912. Because this job was *engineered right* and *applied right,* it is still providing dependable insulation . . . still keeping fuel costs low. Get expert help with *your* insulation problem by writing to Johns-Manville, Box 290, New York 16, N. Y.

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CHEMICAL ENGINEER'S BOOKSHELF

Lester B. Pope, ASSISTANT EDITOR

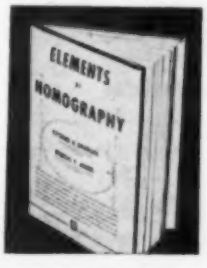
Monographs on Nomographs

ELEMENTS OF NOMOGRAPHY. *By Raymond D. Douglass and Douglas P. Adams. McGraw-Hill Book Co., New York. 209 pages. $3.50.*

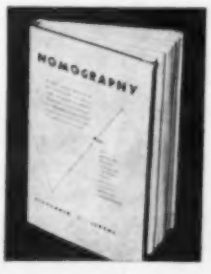
NOMOGRAPHY. *By Alexander S. Levens. John Wiley & Sons, New York. 176 pages. $3.*

Reviewed by L. B. Pope

IF YOU want to make a nomograph to dress up a report, to speed up a long series of repetitive calculations, or just for fun, consult a copy of "How to Make Alignment Charts" by Van Voorhies. This is the book for you if you don't care much about theory.



If you are a student approaching a course in nomography, chances are that the teacher will use "Elements of Nomography" as a text. He will if he's smart. This book, plus a lot of work, will produce a master nomographer. It is the product of two M.I.T. professors (mathematics and graphics) and it is thorough. The authors made it that way, they say, for those who find it necessary to study by themselves. It's a textbook with exercises. It's complete, starting with definitions and winding up with compound diagrams. It features study, understanding, creation and use—with accent on understanding. Two important features are systematic adjustment of scale measurement to base lines and the regular use of prepared forms for standardizing the attack on problems.



Levens (mechanical engineering University of California) has prepared his textbook for a one-semester course. He starts with cartesian coordinate representation and functional scales. He discusses seven equation types. His usual method is to cover theory, give directions, work out a few examples, then present several exercises. A chapter on miscellaneous forms shows how nomographs may be combined to solve equations with as many as six variables. The book ends with a discussion of determinants and their use in chart design. There is evidence that this book was not planned for self instruction.

Synthesis Series

ORGANIC SYNTHESES. *Vol. XXVII. Ralph L. Shriner, editor-in-chief. John Wiley & Sons, New York. 121 pages. $1.50.*

Reviewed by Robert C. Elderfield

VOLUME 27 of this well known series lives up to the high standards set by its predecessors. No comment is necessary other than to list the checked preparations which appear in the new volume. These are: β-Alanine, β-Aminopropionitrile and *bis*-(β-cyanoethyl)-amine, Benzalacetone dibromide, Biallyl, α-Bromobenzalacetone, tert.-Butylamine, Carboxymethoxylamine hemihydrochloride, Decamethylenediamine, Diethylaminoacetonitrile, Dihydroresorcinol, 3, 5-Dimethyl-4-carbethoxy-2-cyclohexen-1-one and 3, 5-Dimethyl-2-cyclohexene-1-one, 1, 5-Dimethyl-2 pyrrolidone, 2, 3-Diphenylindone (2, 3-Diphenyl-1-indenone), 2, 4-Diphenylpyrrole, Ethyl α-isopropylacetoacetate, 4-Ethylpyrodine, Glycolonitrile, 5-hydroxypentanal, Isatoic anhydride, 6-Methoxy-8-nitroquinoline, 1-Methyl-2-2-imino-β-napthothiazoline, N-Methyl-1-naphthylcyanamide, 1-Methyl-1-(1-naphthyl)-2-thiourea, Mucobromic acid, *m*-Nitrodimethylaniline, 3-Penten-2-ol, γ-n-Propylbutyrolactone and β-(tetrahydrofuryl)-propionic acid, Pseudothiohydantoin, Rhodanine, Stearolic acid, Tetraiodophthalic anhydride, *m*-Thiocresol, *o*-Toluic acid, *p*-Toluic acid, *o*-Toluidinesulfonic acid, 1, 3, 5-Triacetylbenzene.

RECENT BOOKS RECEIVED

Aluminum and Its Applications. By H. Brown & associates. Pitman. $5.75.
Colorimetric Methods of Analysis, Vol. I. 3rd ed. By F. D. Snell & C. T. Snell. Van Nostrand. $4.50.
Corrosion Handbook. Ed. by H. H. Uhlig. Wiley. $12.
Dissociation Energies and Spectra of Diatomic Molecules. By A. G. Gaydon. Wiley. $5.
Industrial Weighing. By D. Considine. Reinhold. $10.
Mechanical Behavior of High Polymers. By T. Alfrey, Jr. Interscience. $9.50.
Micromeritics. By J. M. DallaValle. Pitman. $8.50.
Modern Colloids. By R. B. Dean. Van Nostrand. $3.75.
Preparative Organic Chemistry. Interscience. $8.50.
Research in Industry. Ed. by C. C. Furnas. Van Nostrand. $6.50.

1,188 Pages = 1 Milestone

CORROSION HANDBOOK. *Edited by H. H. Uhlig. John Wiley & Sons, New York. 1,188 pages. $12.*

Reviewed by E. C. Fetter

PROFESSOR UHLIG must be very proud. He has shepherded his flock of experts through an unmapped territory and delivered them sound of wind and limb between the covers of his book. This is the first handbook ever compiled for corrosion engineers. It is hard to see how any corrosion engineer can afford to be without one. It is comprehensive; it is authoritative; it is carefully edited and printed. Given these three, what more could be asked?

"Corrosion Handbook" had its conception in the shop talk of a few corrosionists at the now famous Kure Beach test station. By 1942 the Electrochemical Society had created a new division, the Corrosion Division, with one of its primary assignments the prosecution of the handbook idea. Aided by a nine-man advisory board—men of the Mears, Burns, La Que caliber—Dr. Uhlig pitched in. Phase one of the operation was that of subject organization. What were the individual topics that had to be covered? How were these bits and pieces to be grouped and correlated to produce a whole with unity and focus? Phase two was one of author selection. It was one thing to know what they wanted, quite another to corral a recognized authority to handle each facet of the gem.

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Vitreosil Crucibles permit the production of compounds of real purity; and do not absorb material. It is possible to wind Vitreosil Crucibles with wire for direct electrical heating. Made in glazed and unglazed finish.

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Write for Bulletin No. 8

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Laboratory Mill — for scale testing, analysis, etc., — Capacities 100 lbs. to 2000

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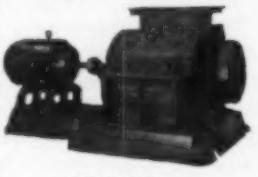
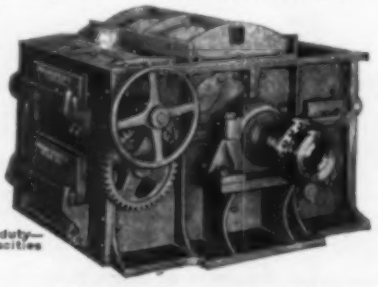
Each precisely engineered to fit a specific process American Crushers offer a capacity range from 100 lbs. to 500 tons per hour. Uniform sizing for friable or fibrous materials in a wide choice of reduction actions. Rolling or patented shredder rings — and three specific hammer types—externally accessible adjustments controlling size of products.



"24" Series—Capacities up to 50 TPH.

Plastics Scrap Grinder—Capacities to 450 lbs. per hour.



"AC" Type—heavy duty—shredder rings—Capacities up to 500 TPH.

Write about your crushing problems or send samples of material.

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Originators and Manufacturers of Ring Crushers and Pulverizers

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Phase three was one of production—authors to be prodded, manuscripts to be edited, proofs to be checked. Altogether, the job took about six years but it's a job well done. It is not hard to find evidence of thought and care each step of the way.

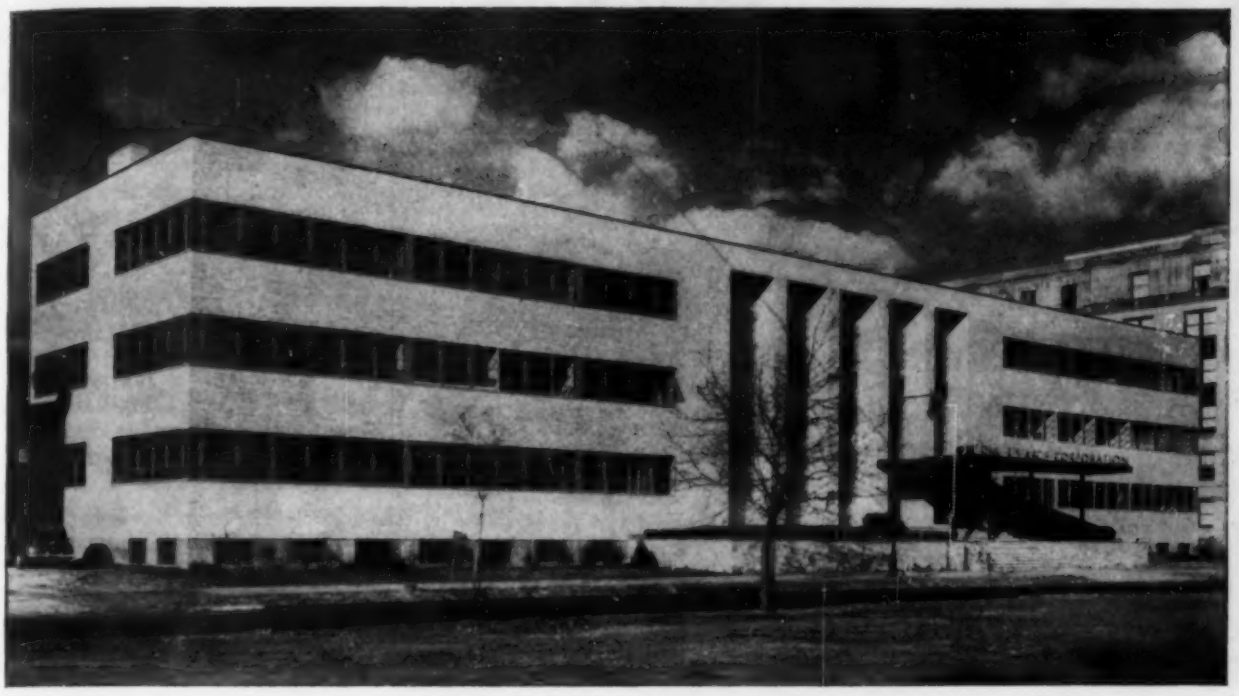
As to coverage of the subject, the editors have got a balanced cross section of present knowledge. We find no conspicuous omissions in their choice of things to talk about. If one were to go looking for fault he might express a little surprise at the amount of space given to sea water and a little disappointment at that given to chemicals. That's not much to quarrel about, and anyway Mr. Vande Bogart, in his introduction to the tables of chemical resistant materials promises that "additional tables will be compiled and published at some later date" to provide ratings for a much longer list of chemicals. Chemicals for which the present tables provide ratings are: acetic, citric, fatty, hydrochloric, hydrofluoric, nitric, sulphuric, phosphoric, and a group of a dozen "miscellaneous" acids; sulphur dioxide; alkalis; and ammonia.

A fast run-down of high spots in the table of contents yields the following:

I. Corrosion Theory: 33 pages
II. Corrosion in Liquids, Atmosphere, Gases: 342 pages—Aluminum, beryllium, cadmium . . . zinc, zirconium; non-metallics.
III. Special Topics: 230 pages—Sea water, soils, micro-organisms, galvanic couples, water systems, steam, boilers, condensate, condensers, lubricants, stress, fatigue, fretting, cavitation, stray currents, special anodes, cable sheathing.
IV. High-Temperature Corrosion: 108 pages—Aluminum, chromium . . . tantalum, zinc; non-metallics.
V. High-Temperature Resistant Materials: 14 pages—Tables showing relative merit of materials for specific high-temperature applications.
VI. Chemical Resistant Materials: 52 pages—Tables showing relative merit of materials for exposure to specific chemicals.
VII. Corrosion Protection: 147 pages—Coatings (permanent, temporary), inhibitors, cathodic.
VIII. Corrosion Testing: 146 pages—Techniques (laboratory, field), specimen preparation, statistical methods.
IX. Miscellaneous: 58 pages—Photos of typical forms of corrosion, characteristics of sea water, tables of general physical data pertinent to corrosion.
Index: 25 pages; glossary: 5 pages.

We said there were no conspicuous omissions. Perhaps there is one after all that is serious enough to deserve mention. What happened to the petroleum industry? One of the most active fields of corrosion research has been in connection with the production and refining of petroleum. Yet "petroleum" and "hydrocarbon" are not even listed in the index. Maybe we didn't look in the right places but the only specific reference we could find to petroleum was about a page in the high-temperature section. One may wonder why condensate-well corrosion, for instance, was considered less worthy than some of the subjects that did make the "special topics."

The handbook's second claim to



Buying the Unknown — with Confidence

THE BUYING OF RESEARCH — the financing of a study of the unknown — must always involve uncertainty. But in spite of uncertainty every progressive industrialist realizes his own imperative need for research and his responsibility to buy it with the greatest possible assurance of success.

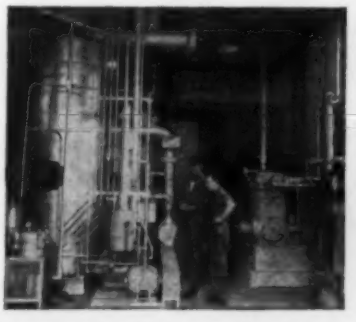
Although success in research cannot be guaranteed it is sure to be commensurate with the brains and experience of the men who engage in it and with the equipment at their disposal.

National Research Corporation is a picked team of young scientists and engineers. Since 1940 this growing staff has been accumulating specialized experience by carrying through to successful completion some of the most difficult and essential development programs that War and Peace have presented. Now in our fine new building in a recognized center of research activity, we have ample space and equipment to serve industry without limitation. Here uncertainty is reduced to the lowest possible minimum.

Our most conspicuous accomplishments, like the low-temperature dehydration of blood plasma, penicillin, orange juice and coffee, the production of magnesium from dolomite, vacuum coating and our work on the famous Manhattan Project, have been in the field of high vacuum. Our Research Division is particularly active in distillation, electronics and metallurgy. In all these fields we do research — and more. We carry on pilot plant operations. We manufacture equipment and we engineer process installations.

You *can* buy research with confidence — confidence based on the fact that at National Research Corporation every knowable factor — ability, experience, equipment — assures a successful and profitable outcome. We welcome your inquiry — particularly if it promises a unique and difficult assignment in industrial process development.

Streptomycin plant of Merck & Co., Inc., Rahway, New Jersey



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We now offer quick delivery on all-welded stainless steel vessels of all types, in large quantities. Additional fabricating equipment to handle heavier tonnages of stainless steel has been installed at our Birmingham, Ala., and Pascagoula, Miss., plants.

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Although the initial cost of stainless steel is higher, it is more economical over a period of years because of its longer life and continuing resistance to corrosive agents of all kinds.

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distinction, authority, is evident in the names of the authors. The contributors list contains 103 names and reads like a who's who in corrosion. For example, in addition to the four mentioned above, we find names like Burghoff, Clapp, Evans, Franks, Hiers, Kendall, Maxwell, Pratt and Speller. And that is only a casual, random sample. The list is full of top-drawer experts. It would, in fact, be hard to think of even half a dozen prominent corrosion workers who have not contributed.

Finally, there is the third score on which the handbook deserves recommendation. It is well edited and carefully produced. Editor Uhlig has the reputation for being meticulous and it shows. For example, units have been converted to a consistent system. Index references to tables, figures and footnotes have been so designated by appending a *T*, *F*, or *FN* to the page number. Overlapping, a constant danger in any multi-authored work, has been minimized by frequent, and apparently conscientious, cross referencing. Charts and drawings are clean, well labeled and consistent in style. All of these things take time and work. In themselves they may not be breathtaking, but they add up to a strong suggestion of probity throughout.

All in all we suspect that the Electrochemical Society has made a historic contribution to corrosion literature. If we could, without being premature, make suggestions for future editions we would limit them to these two—that more chemicals be added to the tables of section VI, and that attention be given to the special problems of the petroleum industry.

7,500 Materials

MATERIALS HANDBOOK. *Sixth edition. By George S. Brady. McGraw-Hill Book Co., New York. 831 pages. $7.*

MOST obvious change in the newest edition of Col. Brady's "encyclopedia for purchasing agents, engineers, executives and foremen" is the addition of a Part II. This used to be the appendix. It has been expanded and is now "Elements of Materials Economics." In addition to the various tables of units of measure, physical and other data from the earlier edition, Part II now has brief articles on geophysics, nuclear physics, geology, production of plant and animal materials, waves and colors, flavor, biotics, textile and drug terminology, government agencies, and visual aids.

Balance of the book remains essentially the same. A few minor errors were corrected. A number of entries have new bits of information while some have been tightened up by judi-

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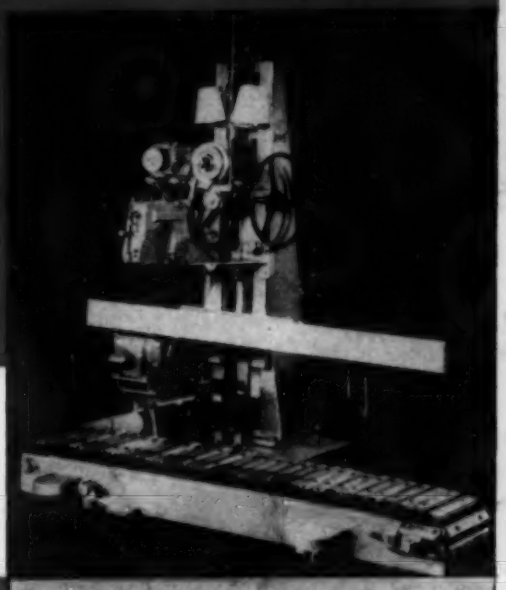
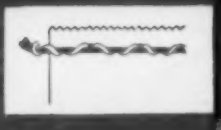
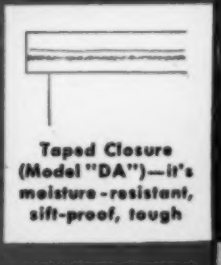
Check the features of both BAGPAKER models shown at the right. One provides high speed, dependable closing; the other, in addition, gives a closure that resists moisture and is proof against contamination and sifting.

You're apt to discover more profitable closing and handling methods . . . more efficient multiwall bag uses, by discussing your needs with a BAGPAK engineer.

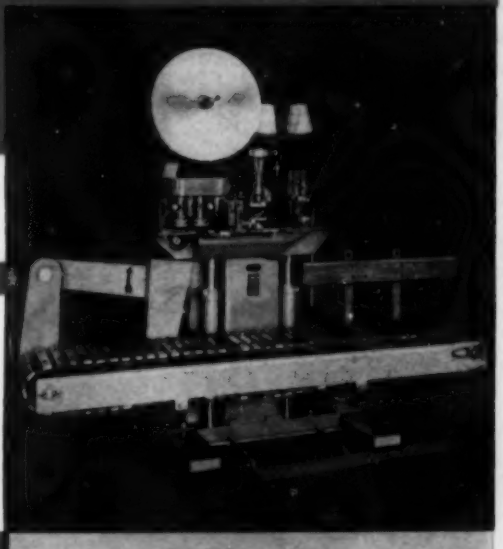


MODEL "E 1" (portable)—closes up to 15 bags per minute. A single foot pedal controls both conveyor and sewing head. Handles both paper and textile bags.





Taped Closure (Model "DA")—it's moisture-resistant, sift-proof, tough



MODEL "DA" (portable) applies tape over "cushion stitch", making a tight seal. One operator, filling and closing, can handle 2 to 4 bags a minute . . . 6 to 12 where filled bags are delivered to BAGPAKER conveyor. Sewing operation starts and stops automatically—no tape wasted.

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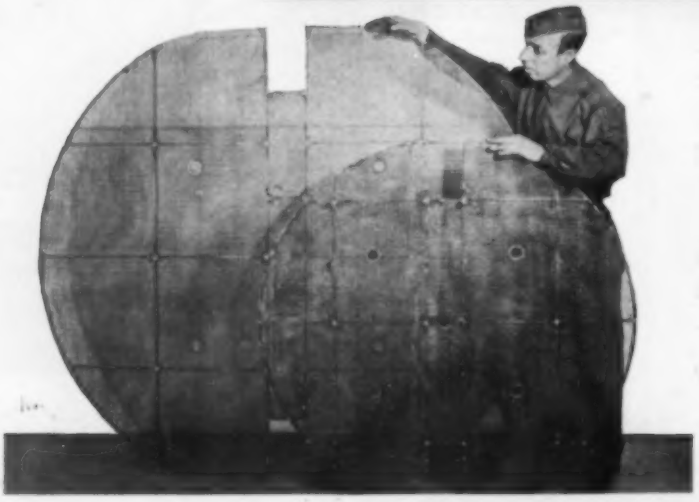

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Compact Book

PHYSICAL CHEMISTRY. *By E. D. Eastman and G. K. Rollefson. McGraw-Hill Book Co., New York, 504 pages. $4.50.*

Reviewed by Robert L. Harris

THIS TEXTBOOK presents the material given during a one-year course in physical chemistry for third or fourth year students at the University of California. The more advanced sections of the book are marked with stars and may be omitted without breaking the continuity. Some of the chapters are introduced with brief but excellent outlines of the historical development of the subject. The explanations of the uses of the various equations and methods of physical chemistry are good because they often point out the limitations as well as the usefulness of the method under consideration. The general manner of presentation is rigorous, and the definitions are well-written.

The authors were intentionally concise, and they have achieved one of their goals, a compact book. Certain sacrifices were made. The text contains relatively few drawings, and many of the derivations are merely outlined in brief paragraph form rather than being presented completely, step by step, and line by line. Laboratory technique is completely omitted. This is not serious because physical chemistry courses are usually conducted with a laboratory manual, but the omission of experimental procedures weakens considerably the chapters on atomic and molecular structure. The student who has not taken a course in atomic physics will be left with a collection of facts but will have very little understanding of their origin and use. There is no chapter on the colloidal state, although a 12-p. chapter on surface phenomena discusses briefly surface tension, spreading, monomolecular films, adsorption, and electrical charges of surfaces. The reviewer could find no mention of parachor and only incidental mention of dipole moments.

Inorganic and Organic

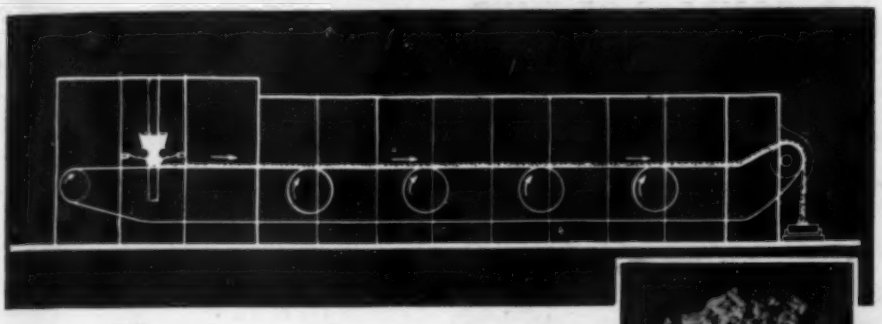
VOLUMETRIC ANALYSIS. *Vol. II, second edition. By I. M. Kolthoff and V. A. Stenger. Interscience Publishers, New York. 374 pages. $6.*

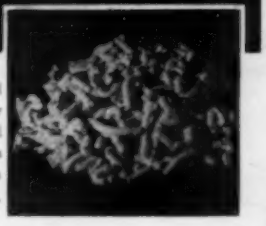
Reviewed by Edwin W. Blase

THIS VOLUME is a modern and comprehensive text presenting critically selected methods for the volumetric

CHEMICAL Drying DATA
BULLETIN NUMBER 1
PUBLISHED MONTHLY FOR PROCESS INDUSTRIES EXECUTIVES AND OPERATING PERSONNEL

PROCTOR CONTINUOUS CONVEYOR DRYING SYSTEM WITH "EXTRUDER" FEED SPEEDS AND IMPROVES WET SOLID DRYING





Close-up shows small extrusions formed by Proctor feed. Heated air quickly penetrates bed of material in this form, promoting rapid, uniform drying.

Where large scale production must be combined with maintaining a uniformly high quality in the output of wet solids, Proctor continuous conveyor drying systems are proving to be the answer to the drying problem. Many pharmaceuticals, pigments, fillers, and plastics—where the need is for unvarying quality in tonnage production, are being handled every day in these systems. The systems are by no means radically new, although new applications are constantly being found.

Each system is "tailor made" to suit the physical characteristics of the product and the output desired. However, the same basic system may be applicable to a variety of products with similar characteristics.

One of these basic systems combines a "rolling extruder" feed with a continuous conveyor dryer. This system is applicable only to products that will hold a definite shape after extrusion. Material is delivered to the hopper of the "extruder" feed having been previously mechanically dewatered. It is then forced through a perforated plate by rolls moving back and forth and depositing it in spaghetti-like extrusions on the conveyor of the dryer. Having been "extruded" or preformed into these small shapes, the product is then carried through the dryer on a perforated plate or woven wire conveyor. Drying the product in the form of small shapes permits heated air to penetrate all the way through to the center of each particle. More rapid diffusion takes place and the drying is subsequently more rapid and still uniform.

*Bone Dry Weight Basis
†Commercial Dry Weight

The table below lists six products currently being produced in this type of equipment.

If you have a wet-solid drying problem—Proctor engineers will consider it without obligation. This, or one of the other basic continuous systems, may be your answer. Thorough investigation will tell. In the meantime, if you'd like to know more about Proctor continuous conveyor drying for wet solids, write for either or both of the booklets listed below.

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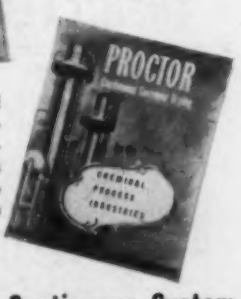
Lucid explanation of the principle of "preforming" and continuous conveyor drying, as particularly applied to the chemical process industries.

Case histories of 11 installations of Proctor continuous conveyor dryers combined with preforming feeds. Complete details on how systems apply to 11 different products.



Products Preformed by Extruding—Dried in Proctor Continuous System

MATERIAL	PRELIMINARY EQUIPMENT	METHOD OF PREFORMING	MOISTURE CONTENT AT BEGINNING OF CYCLE (B.D.W.B.*)	DRYING TIME	MOISTURE CONTENT AT END OF CYCLE	HOURLY CAPACITY (C.D.W.†)
Titanium Dioxide	Rotary Filter	Extruded	94.5%	75 min.	0.25%	31 80 lbs.
Sulfa Drugs	Batch Centrifuge	Extruded (Special grid type extruder plate)	105.5%	100 min.	0.32%	400-425 lbs.
Clay	Continuous Filter	Extruded	42.1%	42 min.	3.1%	4160 lbs.
Finished Lithopone	Frame Filter Press	Extruded	43%	52.5 min.	0.1%	4000 lbs.
Zinc Oxide	Continuous Filter	Extruded	69.5%	105 min.	0.25%	1.830 lbs.
Rubber Accelerator	Continuous Filter	Extruded	184%	101.5 min.	0.3%	1200 lbs.

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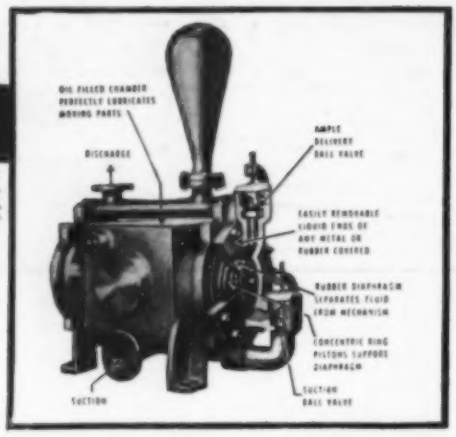

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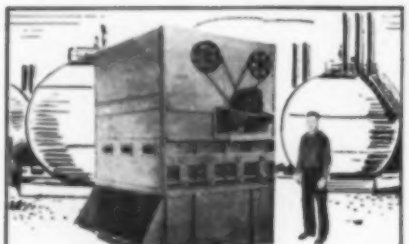
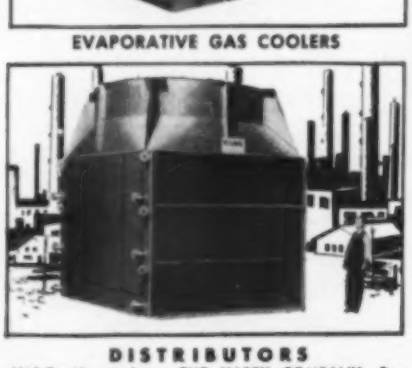


EVAPORATIVE GAS COOLERS



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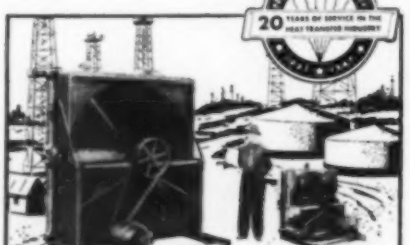

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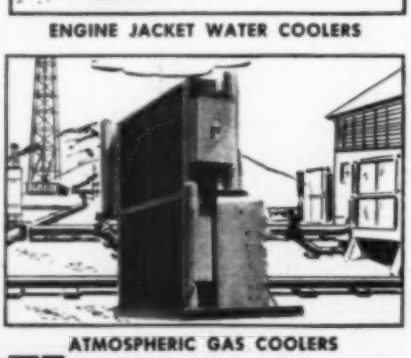

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determination of inorganic and organic substances. The procedures have been chosen for their reliability and usefulness.

Acid-base titrations; titrations involving displacement, hydrolytic precipitations and complex formation; argentometric methods; other precipitation methods; and procedures dependent on formation of slightly dissociated compounds are discussed. Volumetric techniques and standard substances are also considered.

A valuable feature of this book is the accuracy which may be expected from the various methods. Each procedure is presented thoroughly with a careful study of interfering substances. References to the literature are numerous.

The chemist will find this volume a valuable reference book. The theoretical principles have been outlined in Vol. I and therefore have been kept to a minimum. While it is not possible to discuss all procedures in one book, this volume has presented a large number of reliable volumetric analyses covering a wide field. Oxidation-reduction methods of analysis will be published at a later date.

Phenol Plastics

PHENOPLASTS. *By T. S. Carswell. Interscience Publishers, New York. 267 pages. $5.50.*

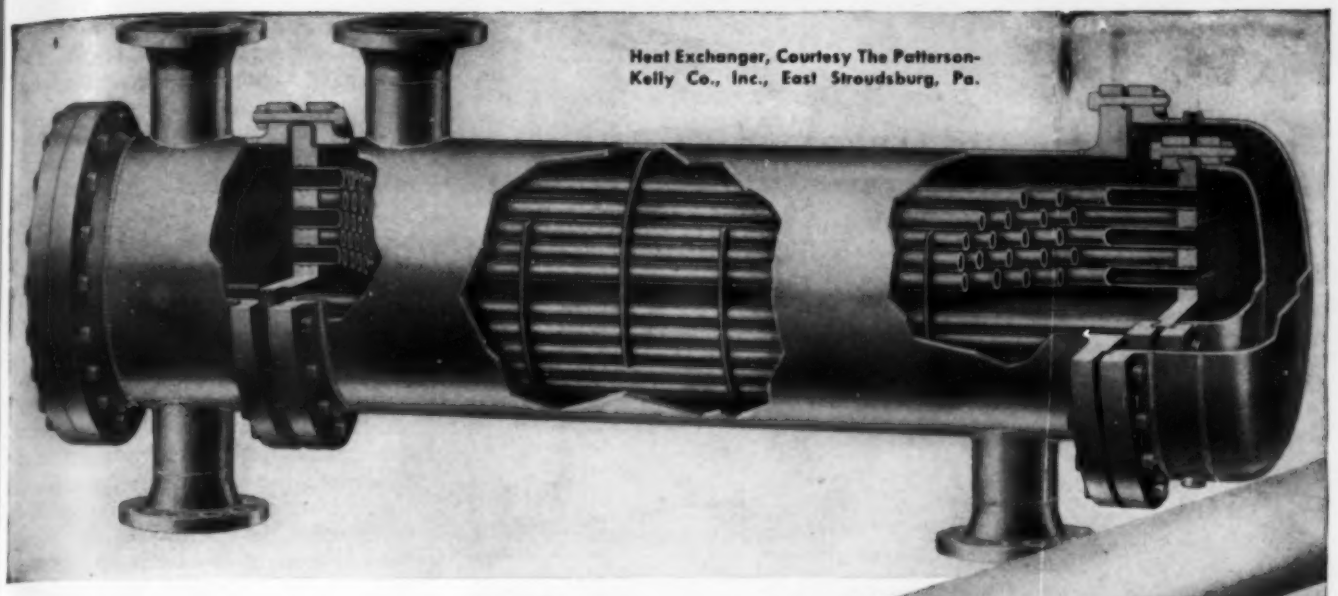
Reviewed by Paul F. Bruins

MANY volumes have been written on the application, manufacturing methods, and physical properties of the phenoplasts, such as phenolformaldehyde and the like. In reading the literature, the chemical engineer has difficulty in extracting the theoretical principles involved in the description of the numerous industrial processes. Consequently, he will find Carswell's book of invaluable aid. The author not only describes their physical and chemical structure, but also correlates this structure with their mechanical and chemical properties. Such a record has never been previously collected in one volume and truly belongs in the high polymer series of monographs.

Contrary to any implication that may be made from its title, this book is written in a very simple manner. Phenoplasts are described in concise, clear and easily readable language so that those not familiar with the field can readily follow the smooth flow of ideas.

Organization of the book follows the usual plan of the scientific literature. The theory is first presented, and later illustrated by sketching the more practical aspects of phenoplast application.

The references presented in this vol-



Heat Exchanger, Courtesy The Patterson-Kelly Co., Inc., East Stroudsburg, Pa.

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Bridgeport's Duplex Tubing is available in such combinations as Copper, Red Brass, Admiralty, Muntz*, Cuzinal (aluminum brass), Duronze IV** (aluminum bronze) with steel, monel, stainless, nickel, or aluminum, either inside or outside. Write for Duplex Tubing Technical Bulletin No. 746 and contact our Technical Service Department through the nearest Bridgeport office.

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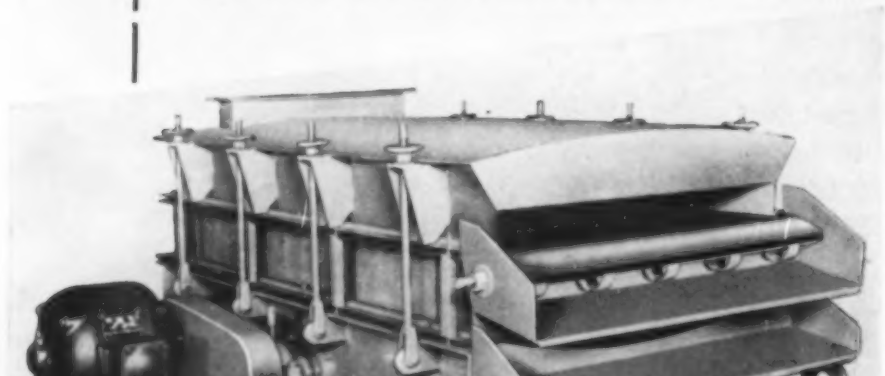

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ume are of a more basic nature, and include very few patents. T. S. Carswell has adopted this policy, as he explains, because of the tremendous volume of patent literature which mainly contributes to the art of manufacture and application of these resins, rather than to the theoretical principles.

Many of the topics in this 267-p. volume are new and informative. The physical and chemical properties of the phenols or polyhydric phenols with the higher aldehydes such as acetaldehyde, butyraldehyde, chloral, furfural, and acrolein, are ably presented. At times the treatment is sketchy, which may be due to the lack of information in the literature. His discussion of the modern theories of cross-linking during the entire stage of cure is by contrast very detailed, especially the isogel and spherocolloid theory, respectively. His presentation of phenoplast fillers is also comprehensive.

Bible for Research Directors

RESEARCH IN INDUSTRY—*Its Organization and Management. Edited by C. C. Furnas. Prepared by and published for the Industrial Research Institute, Inc., by D. Van Nostrand Co., Inc., New York. 574 pages. Price, $6.50.*

Reviewed by S. D. Kirkpatrick

THIS book is bigger than the sum of its parts. It is bigger than any individual or group that contributed to it. It is as big and all-pervading as the subject it so ably presents. In short, it is a book industry has long been waiting for; a book that can have a great influence in advancing science and technology on many fronts.

A great deal of credit should go to Lynn A. Watt, D. G. Smellie, and F. S. Cooper as members of the steering committee from the Industrial Research Institute. They planned, organized, and gave over-all direction to the work on this unique volume. They served with F. W. Blair, Maurice Holland, John M. McIlvain and H. K. Work on the editorial board that enlisted the services of 32 outstanding leaders in industrial research. And they worked closely with the distinguished and experienced editor, Dr. C. C. Furnas, in preparing a volume that for many years to come will serve as a bible for all who plan and direct industrial research organizations.

Between Cliff Furnas' opening chapter on the philosophy and objectives of research and the concluding chapter by Paul Manning on "Goals and Problems for the Future" are 27 separate monographs on practical problems faced by every research director. Problems of organization and management, of selecting research

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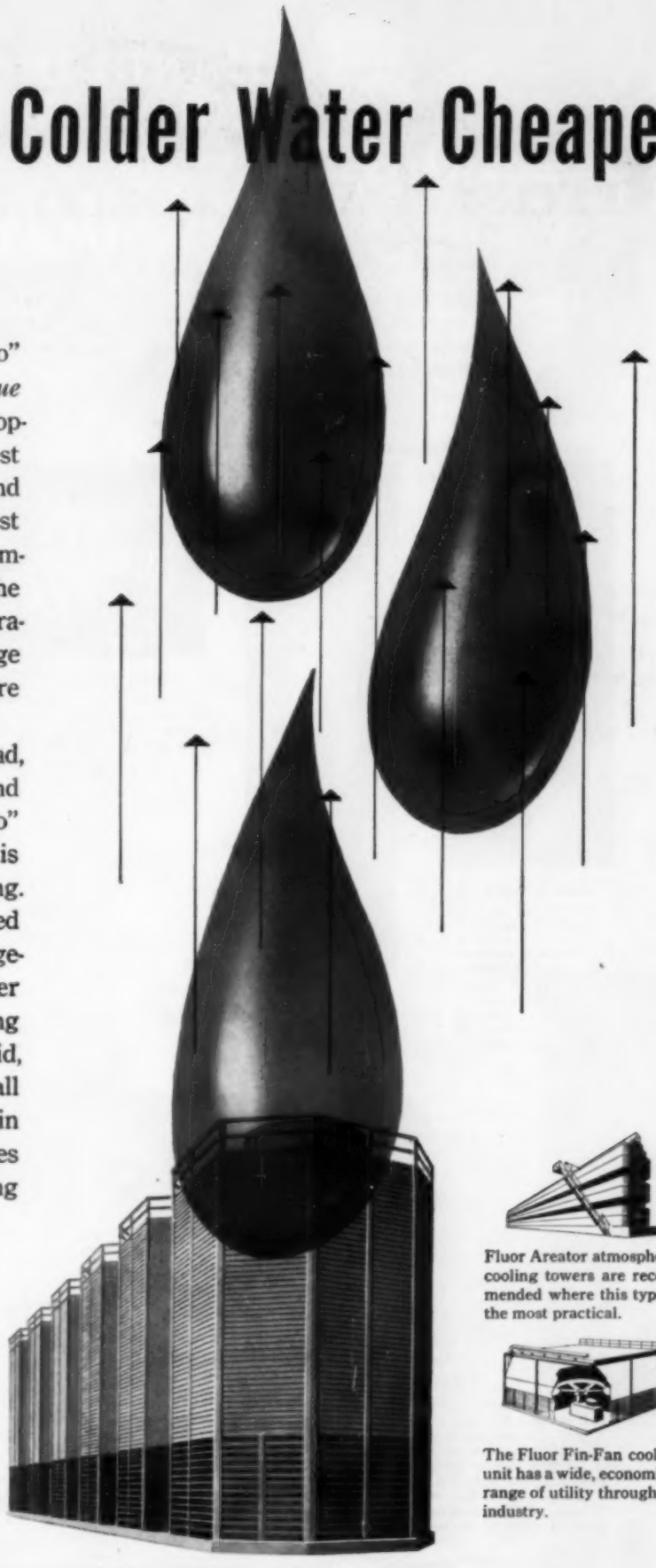

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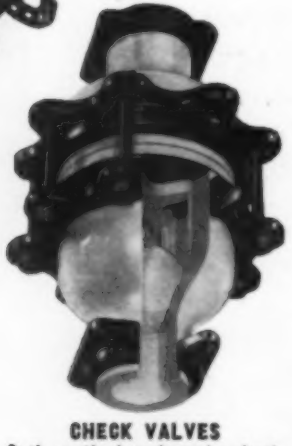

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projects and personnel, of budgets and accounting, of presenting results and translating them into new products and processes, of providing laboratory facilities and services, of establishing proper policies on patents and compensation, of maintaining the best relation with the public and the government—these are treated at length by men of experience and judgment. Useful appendixes include a 20-page bibliography of references (in addition to those cited at the end of each chapter), and several sample forms for employment and patent agreements.

The chapters that appealed most to this reviewer include Norman Shepard's "The Research Director's Job," D. G. Smellie's "Research Reports," Blair and Tucker on "Salary Policy," Fred Olsen's "Evaluating the Results of Research," Hainsworth and Taylor on "Translating Research Results Into New Products and Factory Procedures," and the two by Furnas and Manning previously mentioned.

Dr. Furnas has made no effort to put his authors in an editorial straitjacket. He realized how much might be lost in any rewriting to get uniform style and presentation. He even permits certain mild differences of opinion among his authors and a little over-lapping in spots—just for emphasis. But the end result is a most readable and entertaining book—one that will be read and reread many times from cover to cover.

Basic Data

INDUSTRIAL MANAGEMENT. *Fourth edition. By William R. Spriegel, and Richard H. Lansburgh. John Wiley & Sons, New York. 656 pages. $5.*

Reviewed by Chaplin Tyler

THIS is the fourth edition of a work published originally in 1923 and written by the late Richard H. Lansburgh. The book is written around the machine tool industries rather than chemical process industries and is therefore not of primary interest to chemical engineers. Nevertheless, much of the book is basic to both types of industry, as for example, the chapters on The Historical Background of Industrial Management; The Management Movement; Basic Management Decisions; Plant Location; Organization Development; Types of Organization; Organization, Coordination, and Morale; Product Development and Research; Material Handling; The Basis of Industrial Wages; The Sales Department; The Purchasing Department; Control Through the Use of the Budget; Operating a Budget; Managerial Control Through Costs; The Organization and Policies of the Per-

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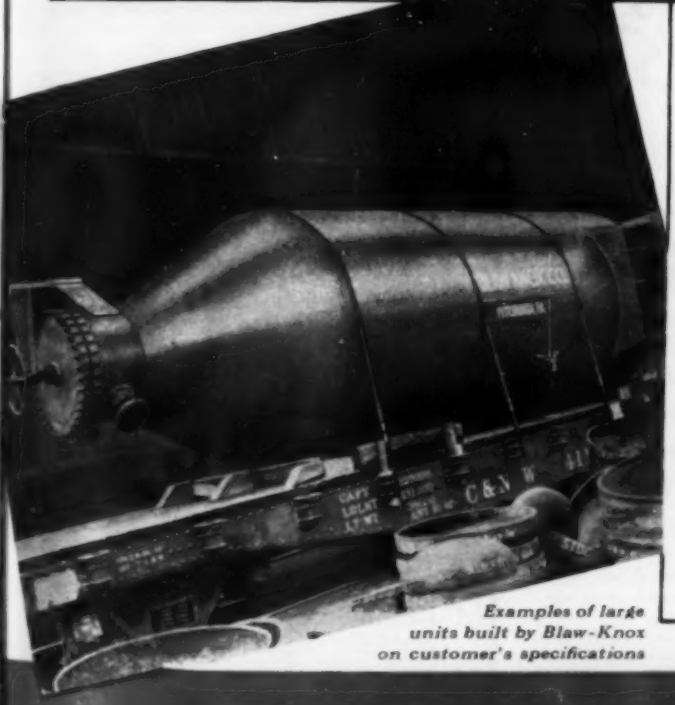

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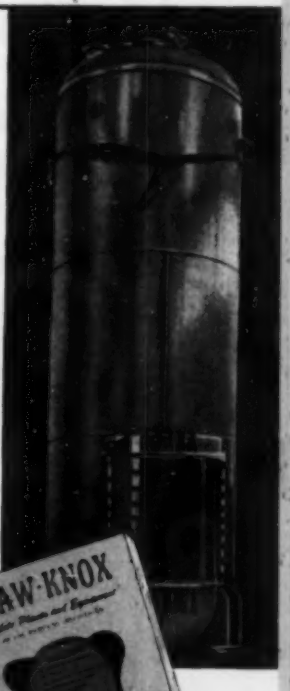

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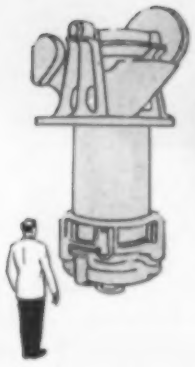

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Instructions

INDUSTRIAL EXPERIMENTATION. By *K. A. Brownley, Chemical Publishing Co., Brooklyn. 151 pages. $3.75.*

Reviewed by Hugh M. Smallwood

THIS monograph is based on a memorandum prepared by Mr. Brownley for the use of those concerned with pilot plant and plant scale experiments in chemical manufacturing in British Royal Ordnance Factories (Explosives). It is intended to provide a guide to modern statistical methods of carrying out significance tests and of setting up efficient experiments.

Within the narrow space of 151 pages, the author includes two chapters of introductory description and definition, followed by chapters on significance of means, the comparison of variances, the x^2 test, Poisson distribution, the analysis of variance, the quality control chart, the relation between two variables, multiple correlation, the general analysis of variance, miscellaneous aspects of analysis of variance, balanced incomplete blocks, compounding, and general conclusions. There are also 7 pages of abridged tables of the usual functions used in statistical work.

This tremendous compression is attained by the omission of practically all mathematical background and descriptive discussion of the techniques and their application. Mr. Brownley has planned a practical text. He has achieved a book of instructions which will guide the novice in setting up specific types of experiments and in analyzing the results. It is doubtful, however, whether a study of this book alone would give sufficient comprehension of the subject to enable useful application of the statistical method by one otherwise inexperienced in these techniques.

Main advantage of this text from the point of view of the chemist is that the illustrations utilize data obtained from chemical operations. This will be of material help to those with a chemical background, since the usual liability of comprehending unfamiliar examples together with new subject matter is thereby avoided. Unfortunately, Mr. Brownley's monograph cannot be recommended to chemists and chemical engineers, because it is so condensed. Even an exceptional

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•HANDBOOK OF NON-FERROUS METALLURGY

Edited by DONALD M. LIDDELL,

Metallurgical Engineer, Lieutenant-Colonel, Air Reserve (Inactive). Prepared by a staff of specialists. *Second Edition*. 656 *pages*, 5¾ x 8¼ 308 *figures*, 200 *tables* $6.50.

Vol. I. Principles and Processes

The first part of a two-volume handbook giving a wealth of detailed, authoritative principles, methods and data for the practicing metallurgist. It is self-contained, with bibliographies and index, and supplies a comprehensive treatment of those operations, apparatus and methods fundamental to all branches of nonferrous metallurgy. Supplies treatment of such processes as drying, crushing and grinding, sampling, screening, classification, etc.; presents data on metallurgical fuels, power plants and accessories, electric furnaces; gives fundamentals of pyrometry and other special techniques, essentials of efficient plant layout, etc. Over 500 figures and tables illustrate the text material.

Vol. II. Recovery of the Metals

Second edition. 721 *pages*, 5¾ x 8¼, 156 *illustrations*, 47 *tables*, *and diagrams* $7.00

The second part of a two-volume handbook, giving the metallurgical engineer an exhaustive compilation of data and methods for the processes involved in the reduction and refining of the various nonferrous metals and their alloys. Complete in itself, the book covers each of the metals with regard to analysis of physical, chemical and mechanical properties and gives a comprehensive study of the metal's sources, abundance, geographical distribution, principal producers, and output. Fully describes standard practice in the preparation and production of the metal and its alloys and by-products.

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student would hardly obtain any adequate grasp of the subject from this text alone.

A number of specific criticisms may be directed against the subject matter of the text. The most important of these is that the proposed method for basing an error estimate on higher order interactions would, if followed literally, surely lead to distorting the conventional levels of significance. Brownley's treatment of this point should be contrasted with Yates, who adopts a much more conservative procedure. There are numerous instances where explanations are omitted to the detriment of the text. To mention a few instances, the difficult concept of an interaction could well be elaborated. The distinction between blocks and treatments is not clearly brought out. The merits of control charts are not compared with those of variance analyses. Instances of this kind could be multiplied, but these are typical of the liabilities of over-compression.

It may be unfair to mention omissions in this text, after criticizing the compression of the material which has been included. In spite of this, it seems that a discussion of randomizing treatments and a description of Yates' valuable method for the analysis of 2^n factorial experiments might well have replaced the brief descriptions of some of the unusual designs such as the Graeco-Latin square and the more complicated types of compounding. A reasonable number of literature references is included, but there is no index.

In general, Mr. Brownley has given an uncritical presentation of available methods. He emphasizes the advantages of these methods, but seldom refers to the pitfalls awaiting the unwary investigator. It is possible that Brownley's book might make a useful companion in the study of Fisher's texts, since it would supply illustrative examples which would facilitate mastering the subject. This, however, seems to be the extent of the utility of Mr. Brownley's monograph.

Brief

FUNDAMENTALS IN CHEMICAL PROCESS CALCULATIONS. *By Otto L. Kowalke. The Macmillan Co., New York. 158 pages. $2.80.*

Reviewed by Kenneth A. Kobe

"THIS textbook is intended for chemical engineering students in their second year. It is hoped that this book will help students bridge the chasm between the conditions under which some fundamental principles were first learned and the conditions under which they are applied." This book is used at the University of Wisconsin

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to prepare the students for the following courses given from Hougen and Watson's "Chemical Process Principles."

Explained in elementary terms are the thermometer scales, density and specific gravity, pressure measurement, molal units, compositions of mixture and solutions, the gas laws, partial pressures, material accounts, crystallization, silicates and slags, combustion calculations, and heat losses in products of combustion. The chapters on crystallization and silicates are so brief that they alone can hardly be of use to a student. The chapters on the gas laws and partial pressures present an excellent elementary discussion including deviations from ideal behavior. The presentation of material balances has been, in the reviewer's estimation, complicated by the use of unknowns and algebraic solutions whereas the simplicity and general applicability of the tie element and the arithmetic methods are overlooked.

This book is too brief and fragmentary to be of value to the engineer or chemist already in industry. In the reviewer's opinion it would be helpful practical material to accompany a freshman chemistry course for engineers.

British Technology

ELEMENTS OF FUEL TECHNOLOGY. *By Godfrey W. Himus. Leonard Hill, Ltd., 17 Stratford Place, W. 1, London. 506 pages.*

Reviewed by R. S. McBride

ONE needing information regarding British fuel-processing and fuel-using methods will find this an informative and interesting volume of general and elementary information. It does not deal with American methods nor American economy. But it still has merit for one who wishes to get a world view.

The book is written at the level of the needs of the engineering student and practicing engineer. Its broad scope makes it useful for anyone without advanced training. In fact it is essentially a textbook for upper classmen pursuing technical curricula.

Libraries which pretend to maintain full reference shelves in the fields of chemistry, engineering, or economics of fuels will need the book.

Terminology

PLASTICS DICTIONARY. *By Thomas A. Dickinson. Pitman Publishing Co., New York. 312 pages. $5.*

Reviewed by Roger Williams, Jr.

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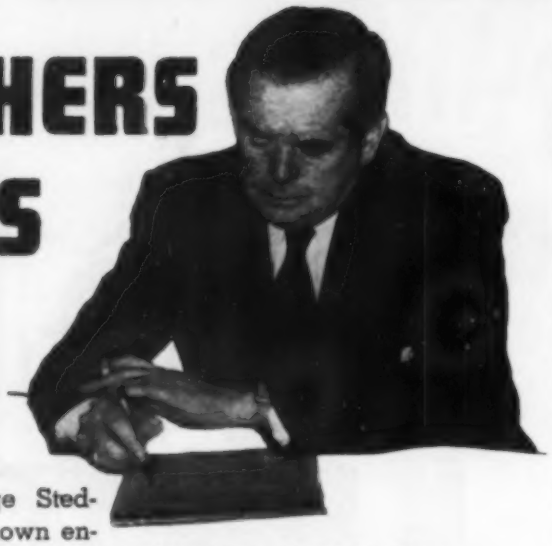

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of data. Chemical engineers who deal with plastics in any form will find it valuable. The appeal is not limited to molders and fabricators. Producers of monomers, plasticizers, and solvents will find it worthwhile. The book covers much more than mere definition of words coined in the plastics industry. Catalysts, fillers, pigments, monomers, solvents, plasticizers and other materials used by the trade are included. The listing of trade names and the chemical identification of the materials is of interest, particularly because foreign products are included. It is too bad that no system of marking was adopted to differentiate trade marks and generic names. Like all dictionaries, it is somewhat incomplete. Some of the newer resins are missing. Despite its shortcomings, the dictionary is a valuable addition to the growing bookshelf of the plastics industry.

RECENT BOOKS AND PAMPHLETS

Sulphuric Acid. Chemical Safety Data Sheet SD-20, published by the Manufacturing Chemists' Association, 601 Woodward Building, Washington 5, D. C. 14 pages. 20 cents. Safe handling and use.

Report on Oil-Engine Power Cost for 1946. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York. 39 pages. Three series of tables covering production costs, comparative costs from 1929 to 1946 and engine details and operating information.

British Plastics Year Book 1947. 17th edition. Published by Illiffe & Sons Ltd., Dorset House, Stamford St., London, S. E. 1. 436 pages. 30s. The plastics industry in Britain is covered in nine sections including Materials, Who's Who, Associations and Federations, Plant and Equipment and Glossaries.

Forging Ahead with Steel Through Research. Published by the Heppenstall Co., 4620 Hatfield St., Pittsburgh 1, Pa. 12 pages. Description of the facilities at the new Pittsburgh metallurgical research laboratory of the company.

Standard Welding Symbols. Published by the American Welding Society, 33 West 39th St., New York 18, N. Y. 67 pages. 50 cents. Includes symbol for 34 welding processes used in industry at this time.

The Relative Efficiency of a Symmetrical versus a Non-Symmetrical Hand Motion Path in the Performance of Short Run Industrial Operations. By John C. Edwards. Engineering Experiment Station Series No. 67, published by the Virginia Polytechnic Institute, Blacksburg, Va. 36 pages. Gratis.

Textile Chemical Specialty Guide, 1946-47. Fourth Edition. Published by Textile Book Publishers, New York. 405 pages. $5. A paper covered buyers guide to textile chemicals and specialties, dyes and colors not included. Last revision, 1942. Arranged in three sections: alphabetical list of manufacturers and their textile chemical products; same products relisted according to use; alphabetical list of brand names and registered trade names.

A. S. T. M. Standards on Petroleum Products and Lubricants (With Related Information). Prepared by A. S. T. M. Committee D-2 on Petroleum Products and Lubricants. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 710 pages. $4.75 in paper cover and $5.40 in cloth

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binding. Contains over 130 test methods, specifications and definitions.

Work in Process. Published by the Sugar Research Foundation, 52 Wall St., New York 5, N. Y. 80 pages. Gratis. A digest of the results of four years of research sponsored by the foundation on the role of sugar in human nutrition and the value of sucrose, its byproducts and derivatives as commercial raw materials.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Annual Report of the Commissioner of Internal Revenue for the Fiscal Year Ended June 30, 1947. Price 40 cents. Includes customary statistics for alcohol and products made with alcohol.

Procedure and Criteria with Respect to the Administration of the "Escape Clause" in Trade Agreements. U. S. Tariff Commission. Processed. A statement on policy prepared in response to a resolution of the Committee on Ways and Means of the House of Representatives.

Manual of Recommended Water-Sanitation Practice. U. S. Public Health Bulletin No. 296. Price 15 cents. Includes precautions on planning, management, and scientific control.

Background Material on Activity in First Year of Distribution of Pile-Produced Radioisotopes. United States Atomic Energy Commission. January 1948. Price 10 cents. Describes work of past year and gives requirements for outside participation.

Lecture Series in Nuclear Physics. United States Atomic Energy Commission, MDDC 1175. Price 55 cents. These lectures were originally given at Los Alamos late in 1943 to aid in training personnel there in the fundamentals of nuclear science. Consists of 41 chapters arranged in six sections: Introduction and terminology; radioactivity; neutron physics; two-body problem; statistical theory of nuclear reactions; and diffusion theory.

Further Developments in Cotton Standardization and Related Activities. U. S. Department of Agriculture, Service and Regulatory Announcements No. 165. Available on request. Includes material on cotton linters, cotton seed, and seed products.

Nonmetalliferous Deposits in the Alaska Railroad Belt. By G. A. Waring. U. S. Geological Survey, Circular 18. Available on request.

The Use of Disinfectants on the Farm. By Frank W. Tilley. U. S. Department of Agriculture, Farmers' Bulletin 1991. Price 10 cents.

Rat Proofing. Prevention of waste of farm materials by destruction or contamination by rats has led to the preparation of several new rat-control and rat-proofing documents available for industrial use on application to Fish and Wildlife Service, Washington 25, D. C.

Selected Values of Properties of Hydrocarbons. By Frederick D. Rossini, et al. National Bureau of Standards, Circular C461. Price $2.75. Buckram. A com-

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Jones Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly. Liberal stocks are carried to facilitate shipments.

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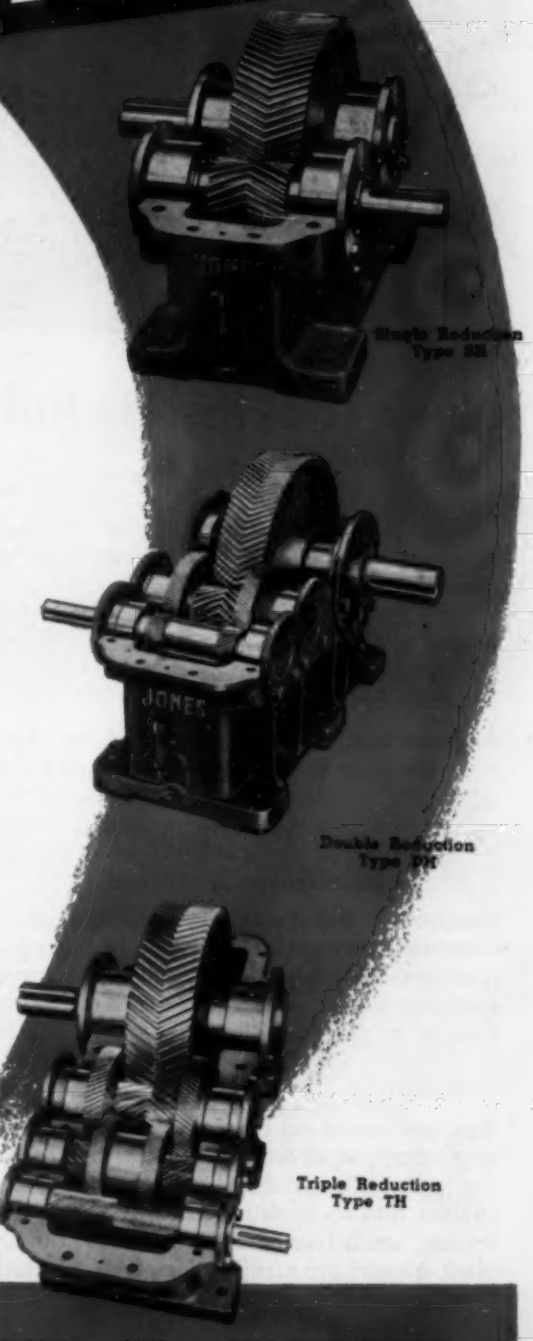

Single Reduction Type SH

Double Reduction Type DH

Triple Reduction Type TH

Jones

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PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

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A new tool called a Grommet Inserter is shown above inserting a rubber grommet in a Sub-Chassis of a Zenith 7H820 Table Model Radio. The inset illustrates a close up view of the Grommet Inserter before and after the grommet has been inserted.

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plete collection of all numerical tables issued by the American Petroleum Institute Research Project 44 as of May 31, 1947. Accurate selected values of the fundamental physical constants and properties of a large number of hydrocarbons are given. Supplements to these tables will be issued later as information develops in looseleaf form through American Petroleum Institute, 50 West 50th Street, New York. The Bureau of Standards and the Superintendent of Documents will not handle the supplements.

Safety for the Household. National Bureau of Standards, Circular 463. Price 75 cents. Valuable in suggestions for general plant use including some portions of industry. Suggested also for use in personnel relations departments to assist staff members in their home safety.

Paints for Exterior Masonry Walls. By Clara Sentel. National Bureau of Standards, Building Materials and Structures Report BMS110. Price 15 cents.

Detergents for the Printer. GPO-PIA Joint Research Bulletin, Materials Series No. 1. Price 10 cents. Includes suggested specifications and methods for use.

Aluminum Metallurgy in the Japanese Empire. By Glenn L. Allen. Bureau of Mines, Mineral Trade Notes, Special Supplement No. 19 (to Vol. 25, No. 4). Mimeographed.

Synthetic Liquid Fuels Abstracts, Items 1-181. By J. L. Wiley and H. C. Anderson. Bureau of Mines. Mimeographed. This begins a new series to be issued periodically in mimeographed form by the bureau. Those desiring to be on the mailing list should address the bureau explaining their interest, as the list will be limited.

Explosions of Ammonium Nitrate Fertilizer on Board the S. S. Grandcamp and S. S. High Flyer at Texas City, Tex., April 16, 17, 1947. By G. M. Kintz, et al. Bureau of Mines, Report of Investigations R. I. 4245. Mimeographed.

Investigations of Explosion Hazards of Perchloric Acid and Mixtures of Perchloric Acid and Organic Materials. By M. A. Elliott and F. W. Brown. Bureau of Mines, Report of Investigations R. I. 4169. Mimeographed.

Annual Report of Research and Technologic Work on Coal, Fiscal year 1947. By A. C. Fieldner and P. M. Ambrose. Bureau of Mines, Information Circular I. C. 7446. Mimeographed. An elaborate resume of work done and conclusions reached during the year ending June 30, 1947.

National Motor-Gasoline Survey, Summer 1947. By O. C. Blade. Bureau of Mines, Report of Investigations R. I. 4248. Mimeographed.

Low-Temperature Carbonization of Coal in Japan. By William T. Reid. Bureau of Mines, Information Circular I. C. 7430. Mimeographed.

Heating-Value Loss of Coal on Air-Drying. By H. M. Cooper, et al. Bureau of Mines, Report of Investigations R. I. 4197. Mimeographed.

Some Refractory Properties of Washington Chromite. By Hewitt Wilson, et al. Bureau of Mines, Report of Investigations R. I. 3694R. Originally issued March 1943, revised December 1947. Mimeographed.

Oil-Well Reconditioning in Southwestern Pennsylvania, West Virginia, and Southeastern Ohio. By Bruce F. Grant. Bureau of Mines, Report of Investigations R. I. 4193. Mimeographed.

A Process for the Production of Iron-Free Alum. Part 1—Laboratory Development. By Edwin A. Gee and W. K. Cunningham. Bureau of Mines, Report of Investigations R. I. 4191. Mimeographed.

Antimony Deposits in Alaska. By Norman Ebbley, Jr., and Wilford S. Wright. Bureau of Mines, Report of Investigations R. I. 4173. Mimeographed.

Flotation of Beryllium Ores. By J. S. Kennedy and R. G. O'Meara. Bureau of Mines, Report of Investigations R. I. 4166 Mimeographed.

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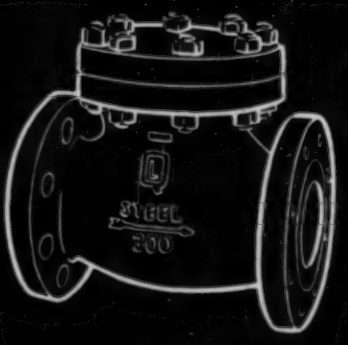

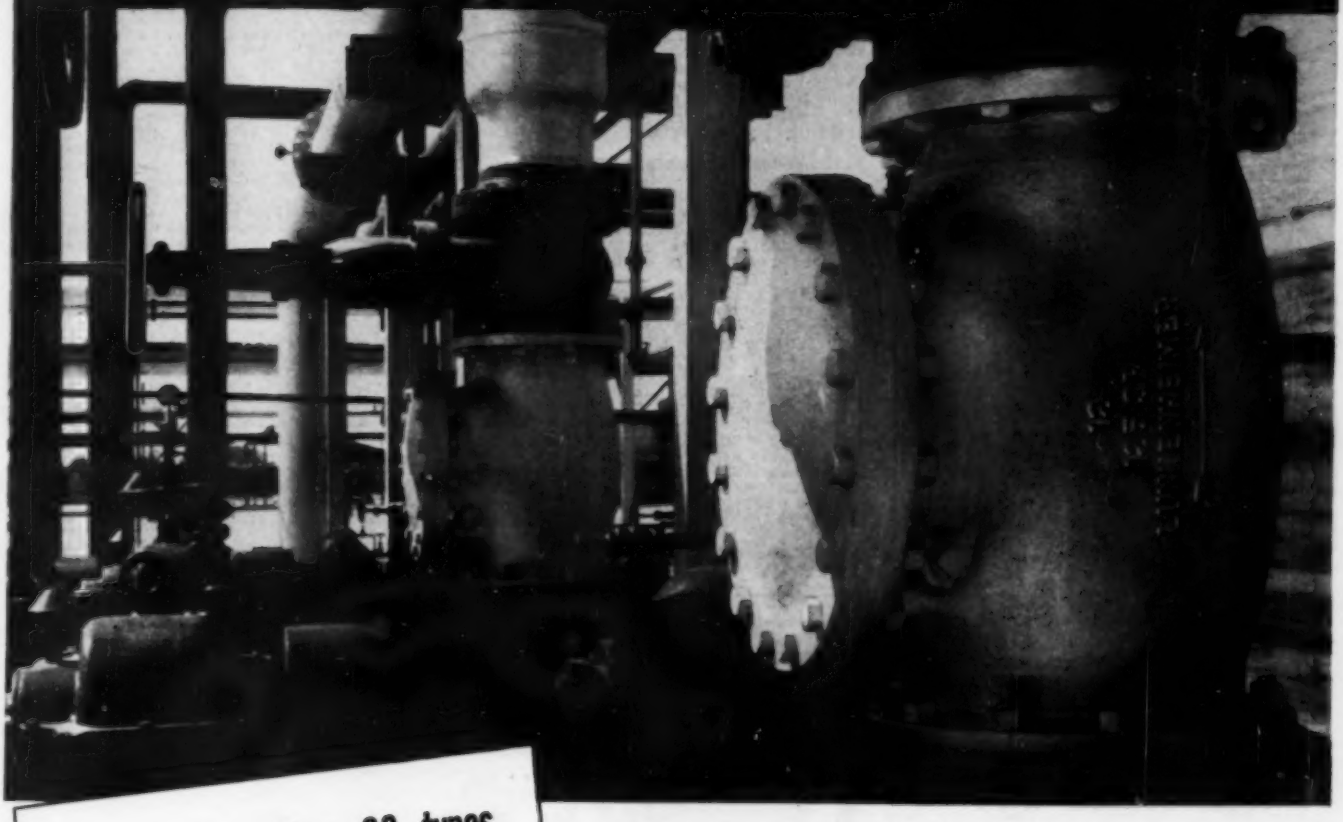

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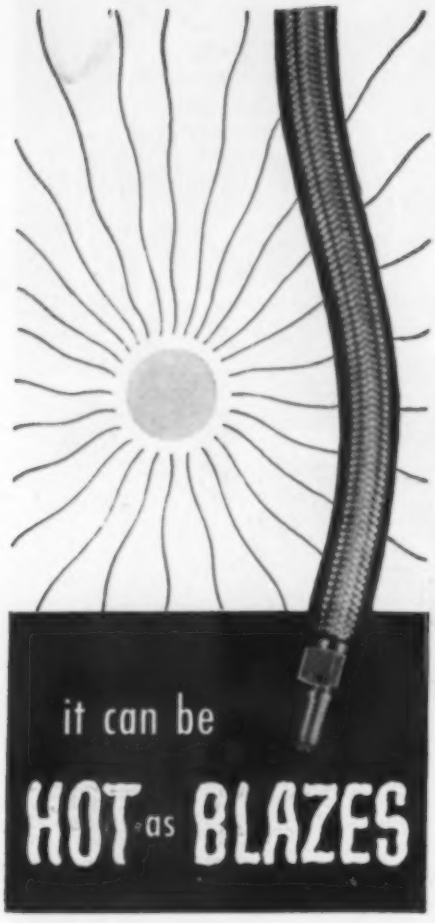

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MANUFACTURERS' LATEST PUBLICATIONS

Chemical Engineering's Reader's Service, in cooperation with manufacturers, makes it possible for you to secure catalogs, bulletins, and other publications herein listed without obligation (unless a price is specifically mentioned). For your convenience, publications may be obtained by using Reader Service Coupons on pp. 159-160.

(Continued from page 160)

shown in a schematic diagram and features of construction are illustrated in cut-away views.

115. Compressors. Ingersoll-Rand Co., Phillipsburg, N. J.—Forms 3132 contains 8 pages illustrating the basic types of compressors made by this company, and their application to the process industries.

116. Chemicals. Virginia-Carolina Chemical Corp., Richmond, Va.—30-page pocket-size manual describing some of the chemical products made by this company. Gives information on phosphorous, phosphoric acids, phosphates, and other chemicals.

117. Process Equipment. The Falk Corp., Milwaukee, Wis.—Bulletin No. 10,080 contains 4 pages describing a back-stop which provides a positive method for preventing reverse rotation on conveyor drives, and other applications where reverse rotation is undesirable.

118. Hydraulic Cylinders. Hydro-Power Div., Hydraulic Press Mfg. Co., Springfield, Ohio—4-page leaflet featuring a midget size hydraulic power unit made by this company.

119. Compressors. Clark Bros. Co. Inc. Olean, N. Y.—Reprint of an article describing a dual control system for compressors in gasoline plants.

120. Scale Models. Industrial Models, Wilmington, Del.—Two-page leaflet describing scale models for engineering purposes.

121. Sintering Hearths. The Mace Co., Denver, Colo.—12-page booklet illustrating and describing this company's sintering hearths for roasting and agglomerating fine materials.

122. Materials Handling. Yale & Towne Mfg. Co., Philadelphia, Pa.—Bulletin P809 is a 30-page bulletin featuring this company's complete line of Work Saver electric trucks.

123. Floor Patching. Smooth-On Manufacturing Co., Jersey City, N. J.—4-page leaflet describing and illustrating the use of this company's iron cement for patching concrete floors.

124. Tensile Strength Testers. Thwing-Albert Instruments Co., Philadelphia, Pa.—Booklet, P-478. 16-page catalog describing the electro-hydraulic tensile strength tester made by this company. Operation is described and the various models are illustrated.

125. Steam Specialties. Cochrane Corp., Philadelphia, Pa.—8-page booklet No. 4340 describes and illustrates the multi-port drainers for continuously removing condensate under vacuum or positive pressures from evaporators, heaters, separators, etc.

126. Instruments. Fischer & Porter Co., Hatboro, Pa.—Catalog Section 53-A. 8-page booklet describing a ratio flow controller for liquid to liquid and liquid to solids proportioning. Contains drawings, and diagrams to show construction details, and applications.

127. Control Valves. Hays Mfg. Co., Erie, Pa.—Folder 117 is a 4-page folder featuring the Electroflo solenoid valve made by this company.

128. Oil Burners—Peabody Engineering Corp., New York, N. Y.—Bulletin No.

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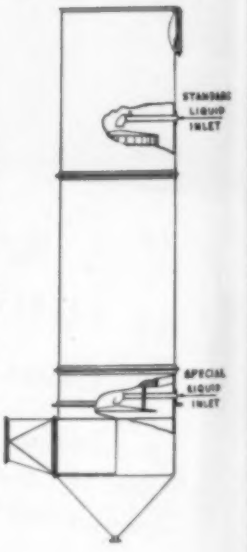
Decontaminate plant air the easy way . . . remove or reclaim materials with a positive-acting, trouble-free Schneible Multi-Wash System. Contaminated air from any process is drawn up through the Schneible Collector into intimate, turbulent contact with the wash liquid. Typical contamination removed: caustic soda, soda ash, lime, glycerin, fatty acids, thalic anhydrides, resins and acrolein. Such recirculated liquids as water, various solutions, oils, etc. are selected to suit conditions.



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for High Temperatures — Heavy Dust Loads

Schneible Multi-Wash Collectors are available for every condition. Extra water inlet can be provided at lower deflector plate to cool high temperature gasses by flash evaporation or to flush heavy materials. Collectors may be built of any material depending on your needs. Exhaust fans are installed on clean air side. No moving parts . . . scrubbing liquid may be recirculated. Send for Bulletin 410.

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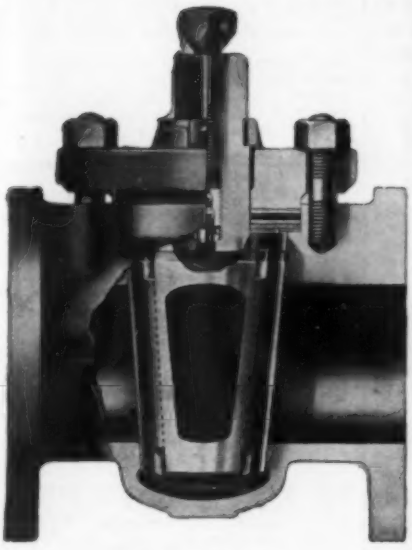
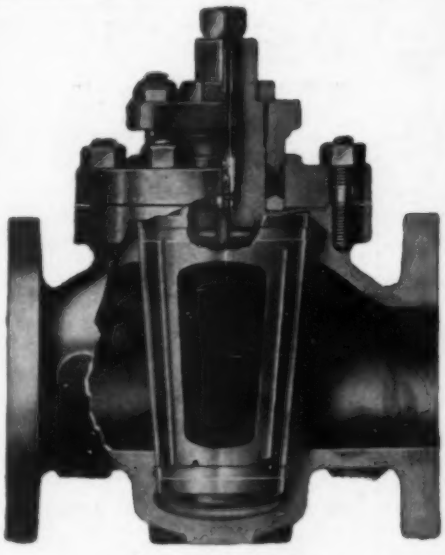
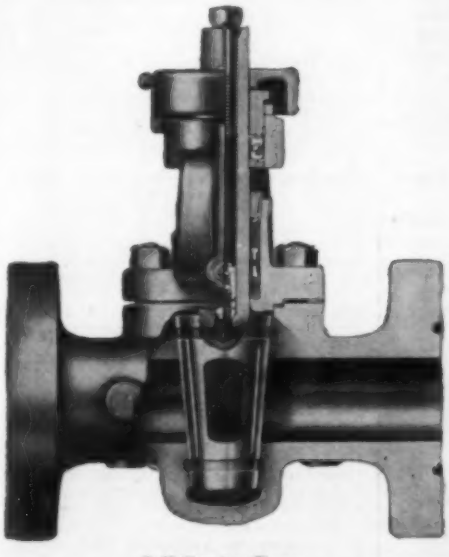


Single Gland Type



Regular Gland Type



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When handling acids, condensates, dyes, oils, solvents, solutions, slurries and hundreds of similar "troublesome" liquids, you get better control, more dependable service and lower operating costs with Walworth Lubricated Plug Valves.

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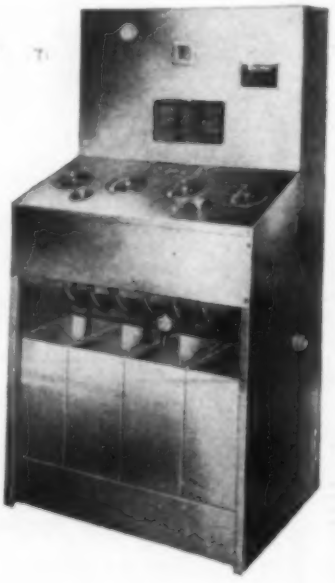
THE combination of improved synthetic resins plus the *upward* flow of the water through the resin beds result in much greater efficiency of operation and higher purity of effluent. UPFLO operation also eliminates completely the need for "backwashing" resin columns — thus valve operations are reduced to a minimum and regenerating time cut nearly in half.

Package Unit

Just Connect to Water and Waste to Operate

Ease of installation is another outstanding feature of these compact units. Comes completely assembled with everything in place — even the resins in columns. All valves, inter-connecting piping and built-in regenerating tanks are included. Cabinet is of handsome stainless steel and has console type control panels. Send for Bulletin 117 for full details.



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First in Pure Water since 1878

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109-A. 4-page illustrated leaflet describing the constant differential wide range oil burning systems made by the company.

129. Screens. Robins Conveyor Div., Hewitt-Robins, Inc., Passaic, N. J.—Bulletin No. 122-A. 4-page booklet describing the Robins Vibrex Screen.

130. Instruments. Electro-Tech Equipment Co., New York, N. Y.—6-page illustrated catalog covering the various types of instruments available from this company.

131. Resin. Irvington Varnish and Insulator Co., Irvington, N. J.—New booklet describes Cardolite, the name given for a group of resins derived from cashew nut shells. A number of applications are outlined.

132. Cosmetic Testing. Evans Research and Development Corp., New York, N. Y.—Methods for testing all types of cosmetics and similar products are outlined in a new booklet available from this company.

133. Heat Transfer Unit. Bethlehem Foundry & Machine Co., Bethlehem, Pa.—4-page leaflet illustrating the Beth-Tec unit which uses a molten salt heat transfer medium in a closed system.

134. Water Treating. Cochrane Corp., Philadelphia, Pa.—Publication 4425. 12-page booklet illustrating equipment for water softening and clarification in which coagulated solids are separated from water. Principle of operation is described and illustrated in a multi-color diagram.

135. Sand Filter. Hardinge Co. Inc., York, Pa.—2-page leaflet featuring the automatic backwash sand filter made by this company.

136. Welding. Lincoln Electric Co., Cleveland, Ohio—6-page folder of illustrated tables and charts, giving standard symbols for arc welding. Includes properties, table of properties of and weld metals.

137. Pipe Fittings. Tri-Clover Machine Co., Kenosha, Wis.—Catalog 647. 8-page booklet describing the Wallace pipe union for light gage stainless steel tubing. Details of constructions are shown.

138. Heat-Treating. Eclipse Fuel Engineering Co., Rockford, Ill.—12-page Information Letter No. 14 describing the application of gas-fired Dowtherm systems.

139. Multi-Wall Bags. Hammond Bag and Paper Co., Wellsburg, W. Va.—8-page brochure illustrates the production of multi-wall paper bags.

140. Adhesives. National Adhesives, New York, N. Y.—24-page pocket size booklet describing the use of this company's adhesives in case sealing.

141. Ventilators. United Electric Motor Co., New York, N. Y.—Bulletin B-148 describes the portable electric motor-driven ventilator for providing fresh air to men working in confined places.

142. Dryers. Proctor & Schwartz, Inc., Philadelphia, Pa.—Vol. 1, No. 1 of this company's new house organ entitled "Proctor Progress." This first issue is a four-page leaflet covering subjects of current interest in the drying field.

143. Instruments. Northern Equipment Co., Erie, Pa.—Bulletin No. 429 B contains 12 pages describing the Copes Flowmatic Regulator for boiler feedwater. Operation of this regulator is described and performance data is shown in curves and graphs.

144. Steam Boilers. Alert Engineering Products, Detroit, Mich.—4-page leaflet describing the packaged unit boilers from 2 to 50 hp. made by this company. Bulletin No. 148.

145. Instruments. R—S Products Corp., Philadelphia, Pa.—Catalog No. 27 describing the Leveltronic relay designed for use in the control of liquid level, interface, pressure and temperature. Schematic wiring diagrams are shown for different types of applications.

146. Concrete Additive. American Bitumuls Co., San Francisco, Calif.—Bulle-

CHEMICAL ECONOMICS

Richard F. Warren, ASSISTANT EDITOR

PROSPECTS BRIGHT FOR CONTINUING PRESENT HIGH LEVELS OF CHEMICAL CONSUMPTION

CHEMICAL consumption continues to maintain high levels in spite of bad weather. The coal strike last month was the latest stumbling block in the upward trend of chemical consumption. This had a direct effect on the coke-oven operations and steel output and the indirect effect of cutting into fuel supplies all over the country. Producers naturally begin to conserve fuel by cutting back production schedules when such a strike takes place and March production will therefore be lower than was anticipated on the first of the month. Up to the time of the strike, most of the major chemical consuming industries were operating at rates above those hit in December. Among those showing considerable gains in the first part of the year were the pulp and paper industry, leather, rayon, coal products, and the paint, varnish and lacquer industry.

Ash Supply Better

Soda ash, one of the scarcest chemicals at the end of the war, is expected to reach a level of output equal to the demand in the near future. Alkali producers and the government have taken action to curb the extremely high prices that have been quoted on the resale market for export. Some exporters have had to pay over 20c per lb. for caustic soda on the gray market. Current export regulations are designed to limit this high price level in exports of this hard-to-get material.

Chemical Engineering's index of industrial consumption of chemicals rose in January to 233.51 with pulp and paper, petroleum refining, glass, rayon, textiles, and plastics contributing to the increase. Fertilizer dropped below the record levels reached in December, but remained well above the level reached in November. While this is below the high of last October it is considerably above the November and December level.

Transportation problems have been a headache for a number of chemical producers and this problem seems to be a continuing one. The tank car and box car shortage will not be solved this year and the increased freight rates have forced a hike in many chemical prices. On the Ohio and Mississippi rivers the use of barges for hauling chemicals has grown considerably. However, there are many sections of the country which cannot hope to substitute water transportation for existing rail service.

Official government figures showing January production of some chemicals are now available. These figures show that ammonium nitrate, chlorine, hydrochloric acid and caustic soda broke all existing records for output in the first month of this year.

Rubber consumption hit a new high in 1947. Consumption passed the annual wartime rates and reached 1,120,000 long tons. In January natural rubber consumption was 3.2 percent above December and 28 percent higher than January 1947. However, synthetic consumption was down 0.5 percent from the last month of 1947, and was 27 percent lower than January of that year. Use of reclaimed rubber rose slightly above the December total, but was about 8 percent below the corresponding month of last year.

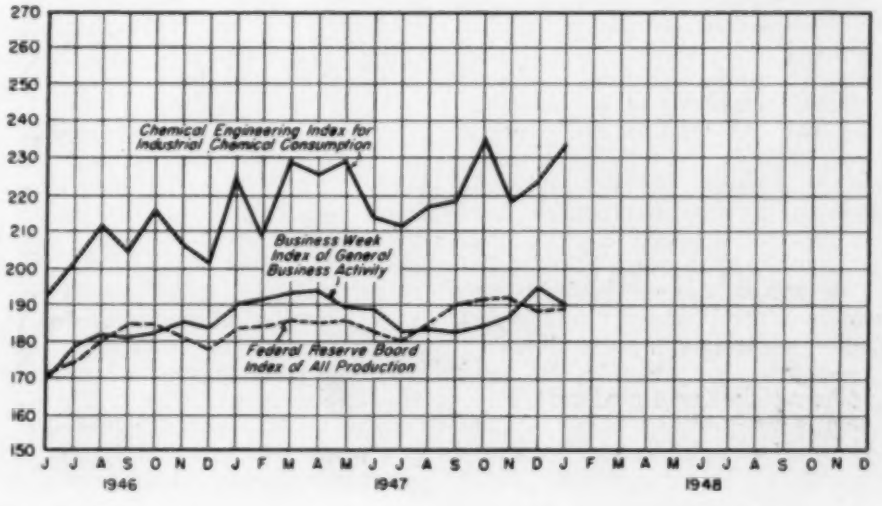
Chemical Engineering Index
Industrial Consumption of Chemicals
1935 = 100

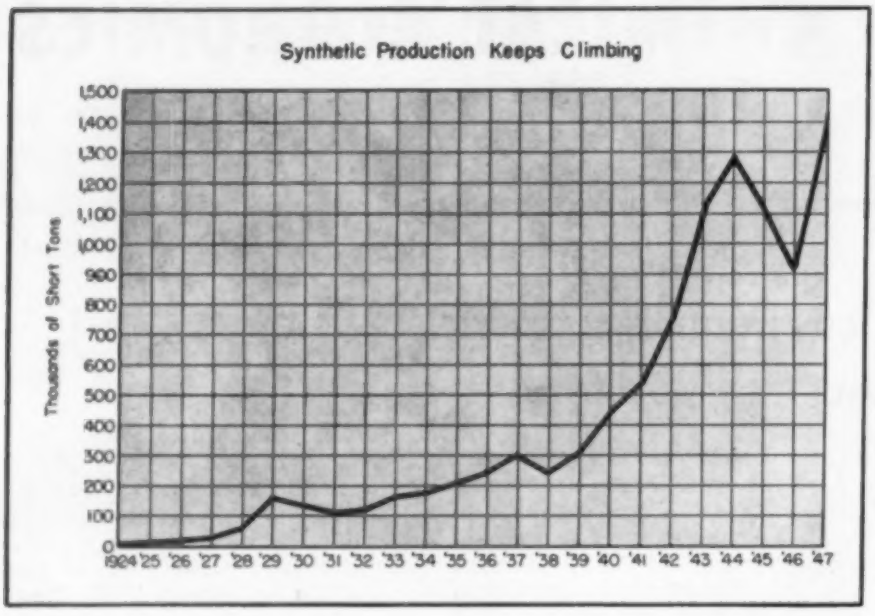
	Dec. (Revised)	Jan.
Fertilizer	57.89	54.80
Pulp and paper	22.30	23.81
Petroleum refining	21.60	21.85
Glass	19.05	19.28
Paint and varnish	19.01	24.48
Iron and steel	13.51	13.62
Rayon	23.40	26.38
Textiles	10.78	11.95
Coal products	11.10	10.72
Leather	4.50	4.76
Explosives	7.58	7.38
Rubber	5.88	5.95
Plastics	8.48	8.53
Total	225.08	233.51

Synthetic Glycerine

Shell's new synthetic glycerine unit has suffered a series of delays and according to trade sources will not be in operation until late this year. Originally, this plant was expected to be operating this summer. When it finally begins operations, it should have a healthy stabilizing influence on the price of the natural product.

Large scale production of synthetic fuel from coal moved closer last month when the government gave Koppers a contract to erect a gas synthesis plant at Louisiana, Mo. Bureau of Mines will operate it. Data will be released to encourage large units.





Anhydrous Ammonia

Synthetic Ammonia Production Is at Record Heights, but the Worldwide Demand for Fertilizer Is so High Shortages Remain

COMMODITY SURVEY

Some five years ago the men who produced anhydrous ammonia were worried. They beheld the giant that the United States Government was building with awe—nearly $300,000,000 being spent to construct ten synthetic ammonia plants, factories with a capacity of several times larger than the greatest previous peacetime consumption of ammonia. Today these same men are happily producing record, but inadequate, amounts of ammonia and are even thinking of expansion.

This turnabout has been caused primarily by the world's food shortage. Emphasis on increased food production both here and abroad has required huge amounts of fertilizer. The record 1947 production of over 1,400,000 tons of synthetic ammonia has not met the demand. Largest new factor in the fertilizer situation is the shipment of fertilizer by the Army to the areas of occupation. Over 20 percent of the U. S. ammonia reaches this destination. So long as high farm income and food shortages continue, and no new plants are built, ammonia demand will remain above capacity.

Prewar, the major producers of ammonia were Allied's Solvay Process Co. at Hopewell, Va., and Du Pont's Ammonia Department at Belle, W. Va. Today, with nine of the ten government-financed plants in operation, these companies no longer have the lion's share of the market.

Government Plants

Five things have happened to the government-financed plants: (1) The plant at Wilson Dam (Muscle Shoals), Ala., has been transferred to TVA. (2) Three plants have been sold. Solvay purchased the Buckeye Ordnance Works at South Point, Ohio. Dixie Ordnance Works at Sterlington, La., was sold to Commercial Solvents. Lion Oil bought the Ozark Ordnance Works at El Dorado, Ark. (3) Two plants have been leased with options for final purchase, Jayhawk at Pittsburg, Kan., to Spencer Chemical, and the Lake Charles, La., plant to Mathieson Alkali. (4) Long term leases are being negotiated by the Army for the Morgantown, W. Va., Etter, Tex., and West Henderson, Ky., plants.* (5) The Missouri Ordnance Works at Louisiana, Mo., is being partially dismantled. Remaining facilities are being converted by the Bureau of Mines for the manufacture of synthetic liquid fuels.

Perhaps the biggest new factors which the wartime ordnance plants brought to the ammonia field were (1) production from cheap natural gas, rather than expensive coke, and

United States Producers

Includes methanol facilities which could be operated in whole or part for ammonia with minor modifications. Capacity shown is in short tons of ammonia per running day.

Owner or Operator	Location	Capacity
Allied Chemical (Solvay Division)...	Hopewell, Va.	900
	South Point, Ohio	660[2]
	West Henderson, Ky.	200
Commercial Solvents..	Sterlington, La.	180[2]
Dow Chemical.....	Midland, Mich.	40
	Pittsburg, Calif.	10
Dupont.....	Belle, W. Va.	650[3]
	Niagara Falls, N. Y.	40
Hercules.....	Hercules, Calif.	30
	Louisiana, Mo.	150[4]
Heyden.....	Morgantown, W. Va.	750[5]
Lion Oil.....	El Dorado, Ark.	450[5]
Mathieson Alkali....	Lake Charles, La.	180
	Niagara Falls, N. Y.	20
Pennsylvania Salt....	Wyandotte, Mich.	35
Shell Chemical.....	Pittsburg, Calif.	280[5]
Spencer Chemical....	Pittsburg, Kan.	400[5]
	Etter, Tex.	220[5]
Tenn. Valley Auth...	Wilson Dam, Ala.	150

[1] Principally a methanol plant.
[2] In partial methanol operation, now or shortly.
[3] Represents maximum ammonia capacity, excluding additional methanol capacity.
[4] Now operated by U. S. Bureau of Mines for production of synthetic fuels; Hercules was wartime operator. Capacity shown is wartime output.
[5] Some small methanol operation reported.

1947 Nitrogen Balance

Quantities shown are short tons per year of equivalent nitrogen.

Supply	
Anhydrous Ammonia	
Commercial plants	916,000
Ordnance plants	262,000
Byproduct Ammonia	193,000
Organic Nitrogenous Materials	30,000
Imports	
Sodium nitrate	89,000
Calcium cyanamide	32,000
Ammonium sulphate	24,000
Ammonium nitrate	33,000
Ammonium phosphates	15,000
Calcium nitrate and misc.	2,000
Exports	
Ammonium nitrate (U. S. Army)	262,000
Ammonium nitrate (commercial)	48,000
Ammonium sulphate	15,000
Ammonium phosphate	8,000
Other nitrogenous materials	4,000
Net domestic supply	1,259,000
Consumption	
Fertilizers	
Solids	
Ammonium sulphate	220,000
Ammonium nitrate	150,000
Other solid forms	60,000
Solutions and liquors	
Ammoniating solutions and Ammonia for mixing	224,000
Ammonia for direct application	21,000
Net imports	121,000
Organic nitrogenous materials	30,000
Conversion and process losses	34,000
Industrial	
Alkalization purposes (other)	65,000
Civilian explosives	60,000
Rayon and nylon	35,000
Plastics and lacquers	30,000
Nitric acid (other)	30,000
Metal treatment	30,000
Naval stores	15,000
Sulphuric acid	15,000
Refrigeration	15,000
Cyanides	10,000
Water treatment	10,000
Fireproofing	5,000
Miscellaneous	51,000
Conversion and process losses	28,000
Total domestic consumption	1,259,000

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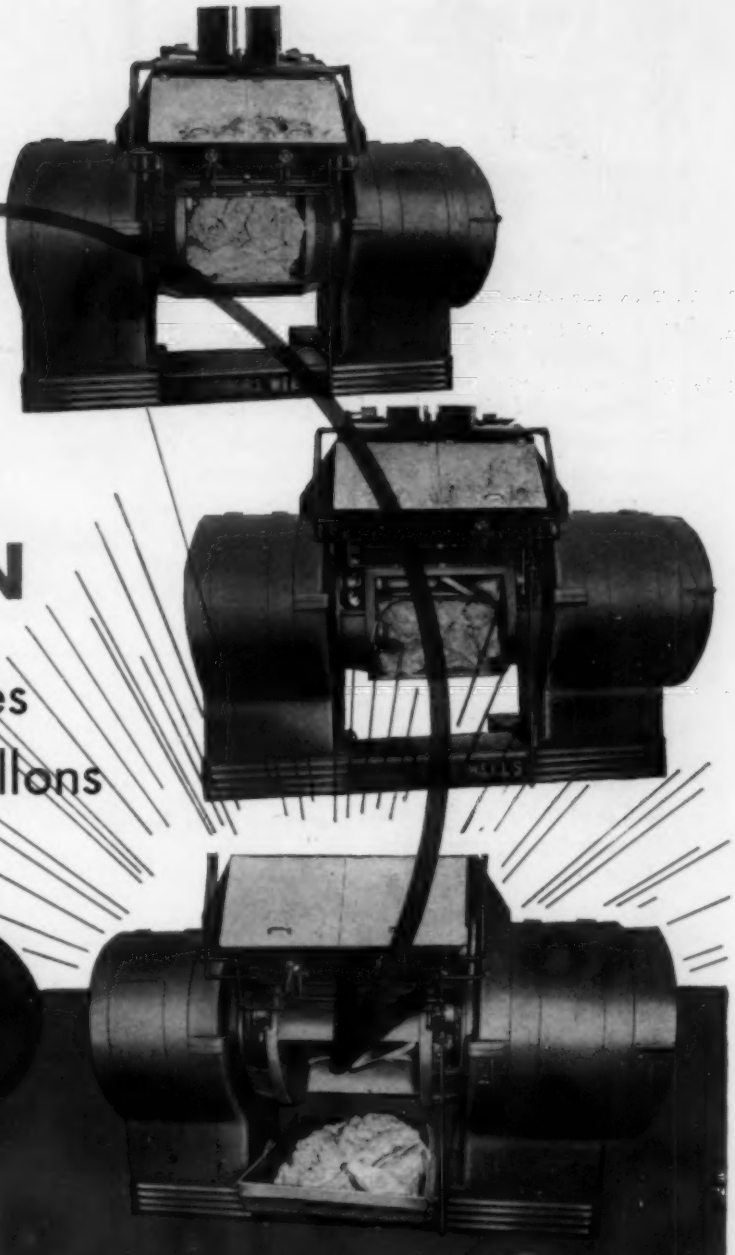

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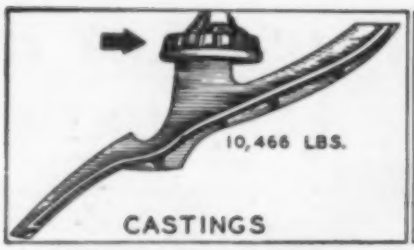

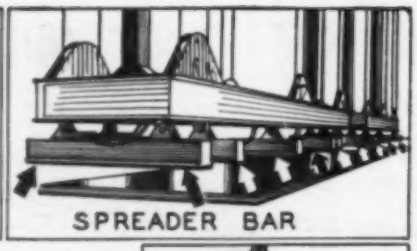

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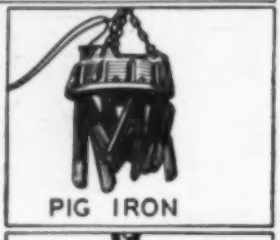

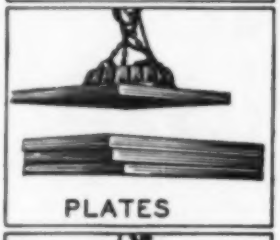

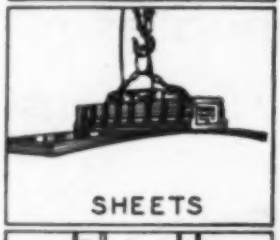

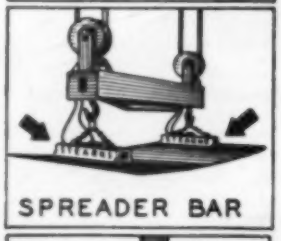

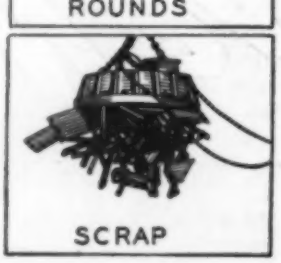

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(2) the emergence of ammonium nitrate as a fertilizer material.

The new natural-gas reforming plants have had production costs well below the older coke-based plants. For many plants, this cost differential is greater than the additional freight for delivery to eastern markets. Rising prices for natural gas and increased freight rates may narrow this margin in the future.

The new fertilizer base, ammonium nitrate, has not been without troubles. This was spectacularly highlighted by the explosion at Texas City early in 1947. Later investigations have developed recommended methods of handling which, it is hoped, will adequately guard against the potential explosive qualities of nitrate. This matter is still being studied.

Nitrogen Statistics

Ammonia demand is necessarily tied up with total nitrogen availability. The best up-to-date nitrogen figures available for current consumption and production of nitrogen have been compiled by L. G. Porter, Production and Marketing Administration, U. S. Dept. of Agriculture. They are shown in box form on page 318. For comparison a table of wartime and use allocations is shown below.

From Porter's data, 1947 over-all production of synthetic ammonia was 1,430,000 tons, 318,000 tons of which was produced at Army ordnance plants for export to occupied areas. This Army export is in the form of ammonium nitrate. The remaining tonnage went 43 percent to industrial uses, and 57 percent to agriculture. When considered in both solution and solid forms, ammonium nitrate was the largest nitrogenous chemical in the domestic fertilizer field, about one-third of the total.

Future Production

Future production rate of ammonia is uncertain. Much will depend on

Wartime Allocation—Anhydrous Ammonia

Jan.-June 1945, Short Tons, 100% NH_3

Export	4,561
Direct military	43,790
Chemical manufacture	68,194
Agriculture	43,328
Explosives	31,700
Aqua ammonia	13,984
Plastics	15,597
Refrigeration	7,890
Miscellaneous	35,574
Total	264,618

Source: U. S. Dept. of Commerce. Note that production from U. S. Army Ordnance plants is not included.

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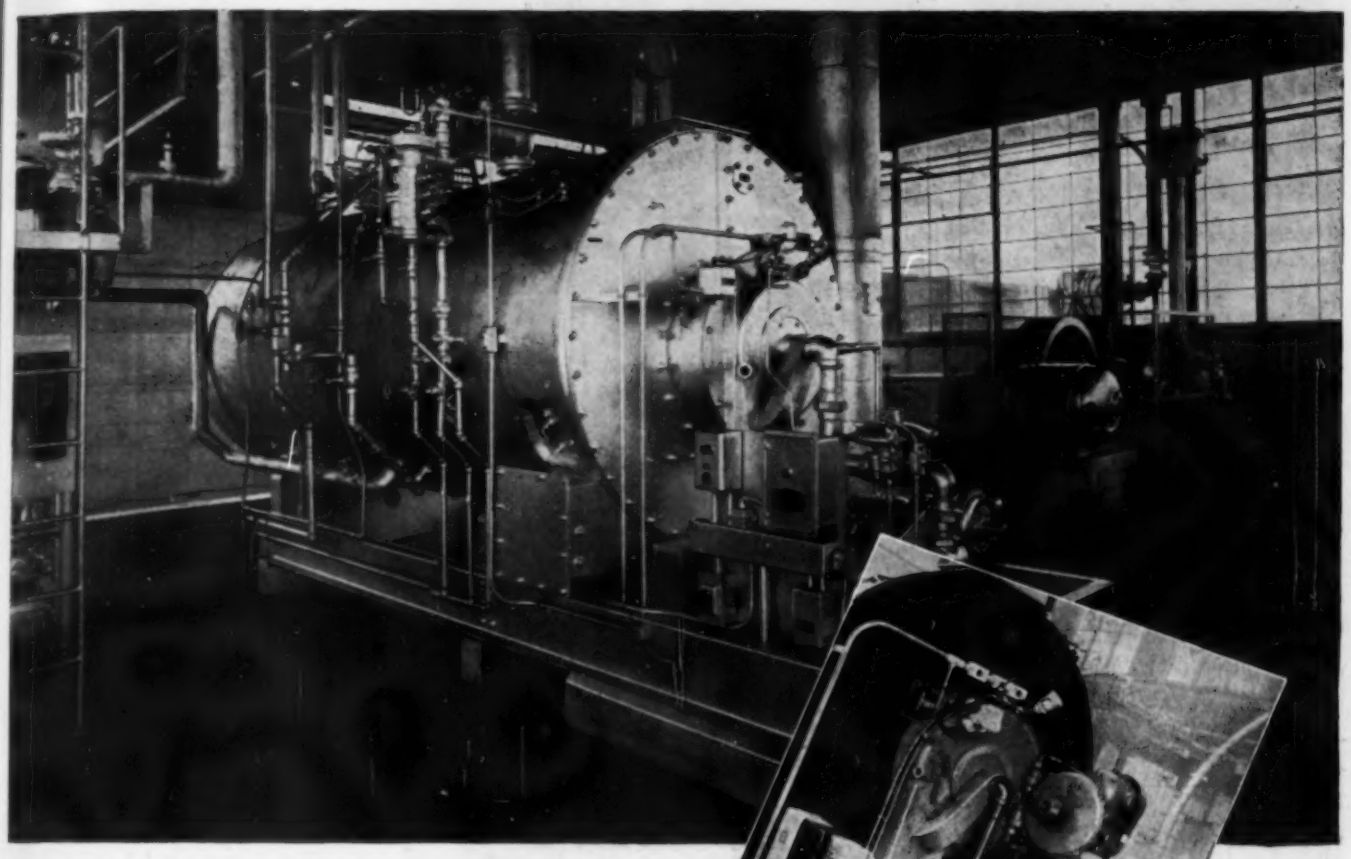

Close-up of combination burner for gas or oil. Oil burner shown in stand-by position for quick change-over.

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how much synthesis capacity is used for methanol production. Construction is almost complete on methanol facilities at the Solvay plant at South Point. The Commercial Solvents plant at Sterlington is being almost completely converted to methanol. Lion Oil and Spencer are beginning methanol output at the El Dorado and Pittsburg plants. Some of this methanol production is not conversion of existing ammonia facilities. Partially built ammonia capacity, which was not completed during the war, is being finished for methanol use. This means that new synthesis capacity is really going in. It is hard to measure the amount, but it is relatively small. Over-all the conversion of ammonia facilities to methanol is probably greater than the new synthesis capacity.

The only increase seen in commercial ammonia output will come on the West Coast, where Shell is again increasing its capacity. Some ordnance plants, notably Morgantown, can raise production. As mentioned above, there are partially constructed units available at some of the ordnance plants which are being or can be put into operation.

Marshall Plan

Ammonia available for domestic consumption will depend on government policy, especially on exports for the Army and FAO allocation. The Marshall Plan countries are the real problem. So far the United States has allocated for 1948 export 61,000 tons of nitrogen from commercial sources, equivalent to 74,000 tons of ammonia. The Army is diverting 47,000 tons of nitrogen (57,000 tons of ammonia equivalent) from the occupied areas to the Marshall Plan nations. But that still leaves a deficit of 190,000 tons of nitrogen (about 230,000 tons of ammonia). The only place that most of this can come from is the United States' domestic supply. Whether or not this demand will be met depends on Washington.

If the Marshall Plan countries were to get their requested nitrogen and proposed conversion from ammonia to methanol is made, the nation's farmers are going to be short of their fertilizer demand. A great deal short. It looks like another 500 or 600 tons of synthesis capacity is needed, particularly as production of existing plants is shifted to methanol. Even then fertilizer demands will not be fully met for some years to come.

* The Cactus Ordnance Works, at Etter, Tex., was recently shut down by a fire which occurred on March 6. Time of resumption of activities cannot be predicted at the time of writing.

The battle of the atoms

Telephone equipment is constantly at war against invisible forces of nature which seek to take it apart, atom by atom. On all fronts, Bell Laboratories chemists must fight corrosion — an enemy able to make a telephone circuit noisy or perhaps to sever it altogether.

An example: for years lead cable had lain protected in wooden ducts. Then in certain areas something began to eat the sheath, exposing wires to moisture. Corrosion chemists of the Laboratories were called in. The corrosion, they found, came from acetic acid generated in the wood during the preservative treatment then in use. They pumped in neutralizing ammonia. Corrosion stopped. Now telephone duct wood is controlled for acidity.

In a large city, smoke-polluted air was coating the silver surfaces of contacts with sulphide. Noisy circuits resulted. Chemists discovered minute traces of sulphur vapor in the air. They filtered incoming air with activated charcoal. Today, the latest telephone contacts are of palladium — not affected by sulphur.

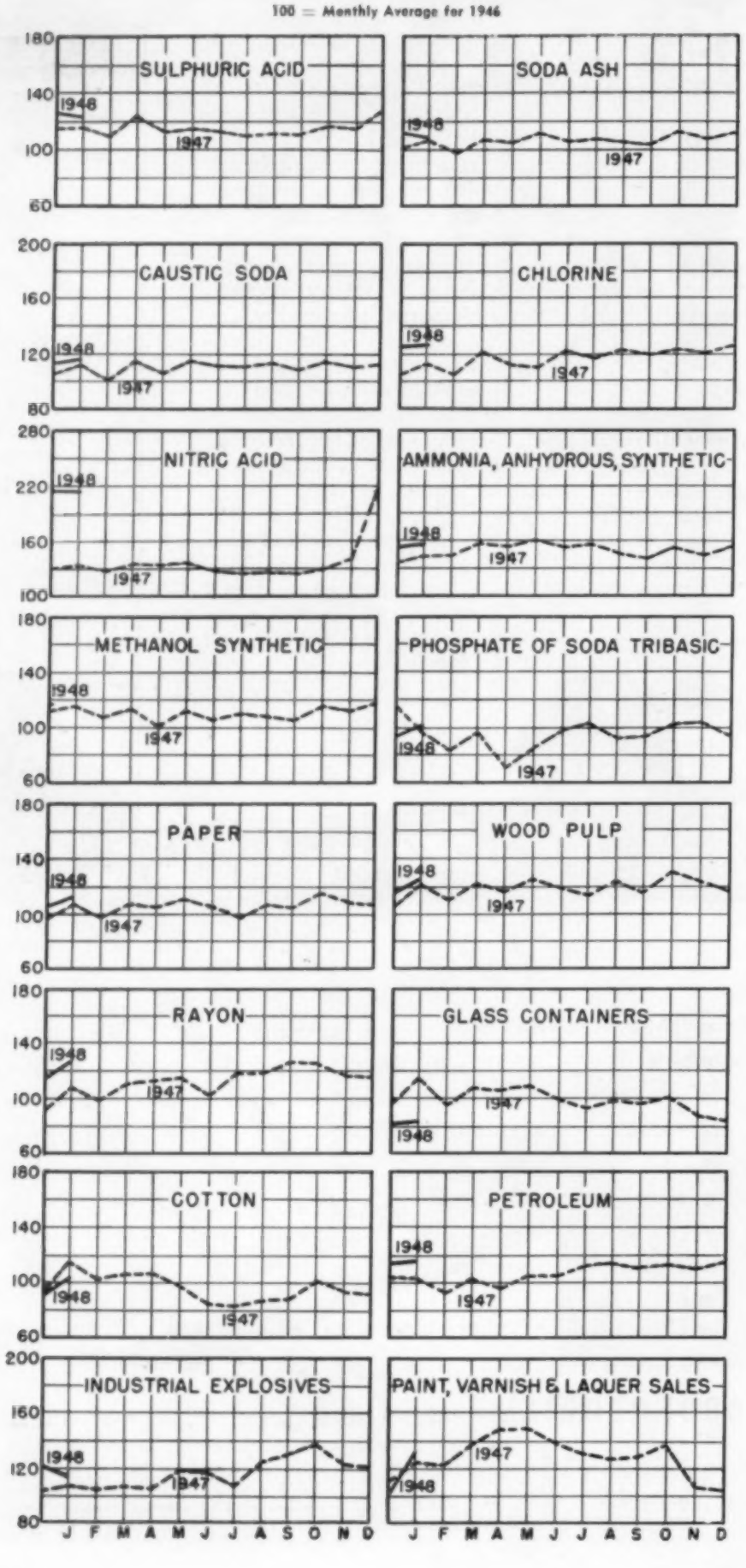
Corrosion in metals is only one type of deterioration which engages Bell chemists against hostile forces. Plastics, paper, metals, rubber, textiles, coils, waxes and woods all have enemies. But knowledge, and persistence, are steadily winning out—to the benefit of the telephone user.

A Bell Laboratories corrosion engineer examining samples during an exposure test on corrosion-resistant finishes and alloys.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

PRODUCTION, PRICE AND CONSUMPTION TRENDS



PRODUCTION of inorganic chemicals has continued at a high level this year, with nitrogen chemicals leading the way. However, last month ammonia production suffered a serious set back when a fire occurred at Cactus Ordnance plant. This plant will be out of action for several months and will, of course, affect production of ammonium nitrate in spite of the fact that this unit did not actually produce the fertilizer.

Reports indicate that Dow will cut back phenol production in the second half of this year to rehabilitate its older equipment. This means a temporary drop in phenol output may be expected. New equipment will continue to operate.

Additional methanol capacities can be expected this year. Commercial Solvents reported last month that its new plant at Sterlington will be operating this spring. As soon as this methanol is available their enlarged formaldehyde unit at Agnew, Calif., will be placed in full operation.

Production of sulphuric acid continued at a high level in January with output falling slightly below the high point reached in December. With the growing number of acid plants coming into production, this chemical will be produced at levels higher than those reached in 1947.

Cotton consumption in February was 785,231 bales compared with 860,202 bales in January. While this looks like a decline, actually the rate of consumption was slightly higher in February.

Price Trends

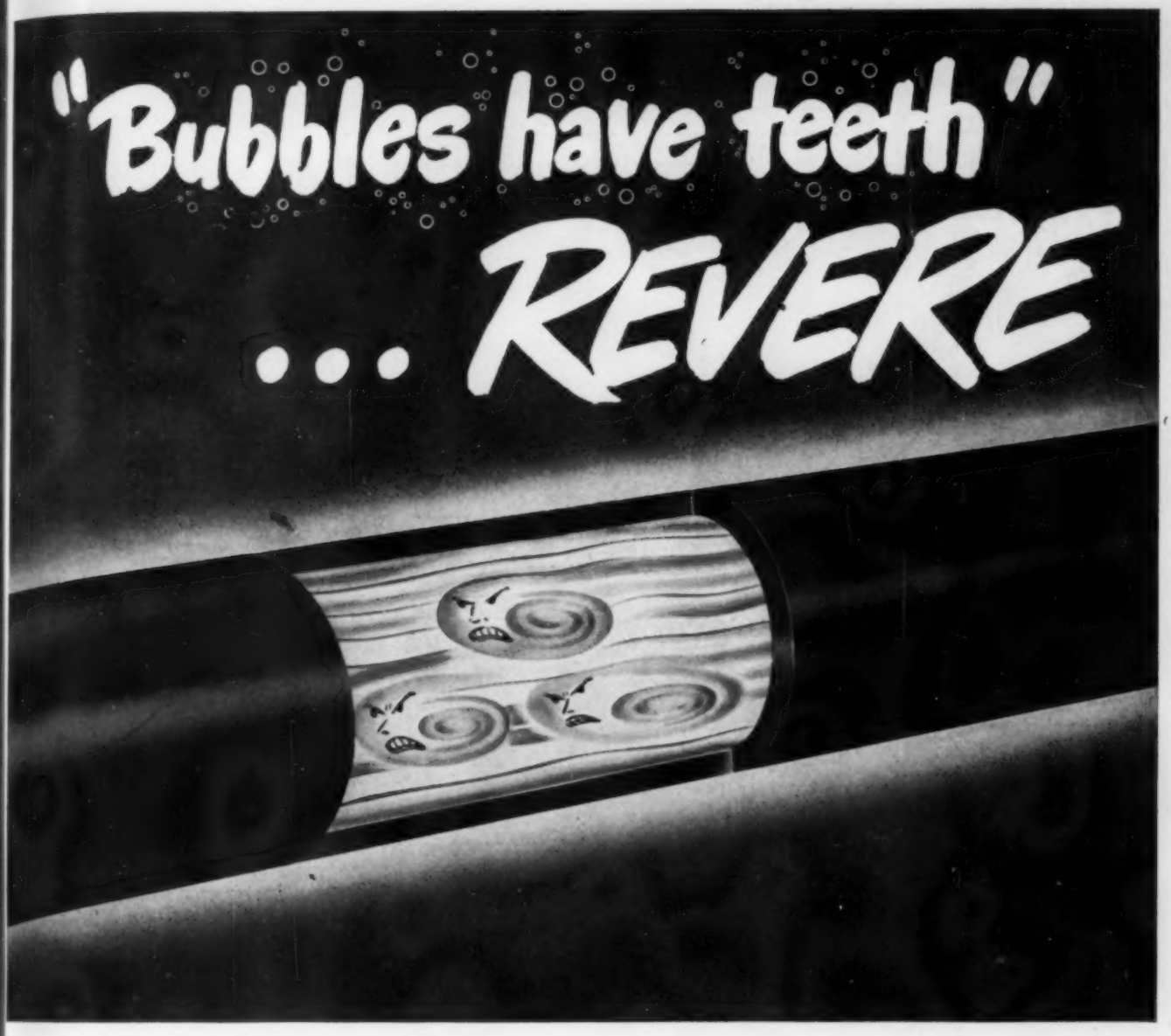
Oils and fats dropped slightly after a big break in February. They have reached a point where demand is firm in most cases. Zinc and lead pigment prices rose this month due to increased processing costs. Raw material and production costs have forced Du Pont to raise the price of methanol to 28c. (a 4c. rise) and also increase formaldehyde, hexamethylene tetramine and paraformaldehyde prices.

Chemical Engineering

WEIGHTED INDEXES OF PRICES

Base = 100 for 1937

	Chemical	Oils & Fats
As of April 1..	129.84	263.43
Last Month ...	128.80	265.67
April 1947	125.30	345.62
April 1946	109.13	145.80



SOME years ago Revere said that "Bubbles have teeth." It is still true. Air bubbles in a condenser can eat away at the tubes quite rapidly, and become a cause of failure with consequent re-tubing. Air-entrainment, as it is called, acts in several ways, all destructive to tubes. Air contains oxygen, which directly attacks most metals, forming oxides. Carbon dioxide in solution dissolves these oxides. That is not all. Air bubbles add to the erosion effect of turbulent flow. The higher the velocity, the worse the effect, and the more swift and serious is the combination of erosion and corrosion at points of greatest disturbance. Every effort should be made therefore to keep air from being carried into the cooling water. If you are troubled by frequent re-tubing of your condenser, get in touch with Revere, but first save a few samples from failed tubes for examination by our laboratories to determine the cause of failure. Many users of condenser tubes have found our collaboration exceedingly valuable, and we are always glad to cooperate in an effort to extend tube life.

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1948

United States Production of Certain Chemicals

January 1948, January 1947

Chemical (Tons unless otherwise noted)	January 1948	January 1947
Ammonia, synthetic, anhydrous[1]	95,405	85,121
Ammonium nitrate, 100 percent	95,357	89,747
Ammonium sulphate, synthetic, technical (M lb.)	35,252	24,487
Calcium arsenate (M lb.)	2,003	1,768
Calcium carbide, commercial	58,091	50,675
Calcium phosphate:		
Monobasic (M lb.)	6,058	6,731
Dibasic (M lb.)	7,440	9,817
Carbon dioxide:		
Liquid and gas (M lb.)	16,445	17,640
Solid (M lb.)	40,741	42,851
Chlorine	123,319	110,080
Chrome green, C.P., (M lb.)	958	1,613
Chrome yellow and orange (C.P.) (M lb.)	4,076	3,608
Hydrochloric acid, 100 percent	39,232	35,144
Hydrogen (M cu. ft.)	2,201	1,651
Lead arsenate, acid and basic (M lb.)	3,229	4,923
Molybdate chrome orange (C.P.) (M lb.)	490	429
Nitric acid, 100 percent	103,834	64,138
Oxygen (Million cu. ft.)	1,270	1,101
Phosphoric acid, 50 percent	95,504	78,862
Soda ash:		
Ammonia soda process:		
Total wet and dry[2]	383,481	380,589
Finished light[3]	189,627	194,825
Finished dense	136,512	129,815
Natural[3]	22,389	18,682
Sodium bicarbonate, refined	13,190	15,485
Sodium bichromate and chromate	7,664	6,979
Sodium hydroxide		
Electrolytic process:		
Liquid[3]	119,085	108,688
Solid	25,170	17,980
Lime soda process:		
Liquid[3]	63,717	64,761
Solid	20,974	21,416
Sodium phosphate		
Monobasic	1,068	1,064
Dibasic	6,563	6,238
Tribasic	8,125	7,811
Meta	2,512	2,144
Tetra	4,949	4,110
Sodium silicate, anhydrous	37,529	39,991
Sodium sulphate:		
Anhydrous, refined	13,015	12,178
Glauber's salt[4]	18,457	17,338
Salt cake, crude, commercial[4]	51,942	48,937
Sulphuric acid:[5,7]		
Chamber process	287,323	291,210
Contact process, new	597,827	546,963
Zinc yellow (zinc chromate) (C.P.)	308	224

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Synthetic Organic Chemicals

December 1947, December 1946, Twelve Month Totals for 1947 and 1946

	December 1947	December 1946	Total, Twelve Months 1947	1946
Acetanilid	699,135	984,534	7,758,793	.....
Acetic acid:				
Synthetic[1]	28,793,845	29,298,123	359,802,923	284,836,346
Recovered	138,789,415	111,609,087	1,459,137,011	1,191,233,817
Natural[2]	2,369,653	2,426,772	26,648,100	28,064,371
Acetic anhydride[3]	57,506,903	48,703,382	628,131,160	521,979,630
Acetone	35,617,855	33,966,787	396,496,995	335,928,996
Acetylsalicylic acid	1,015,677	964,602	11,346,077	9,852,167

(Continued on page 328)

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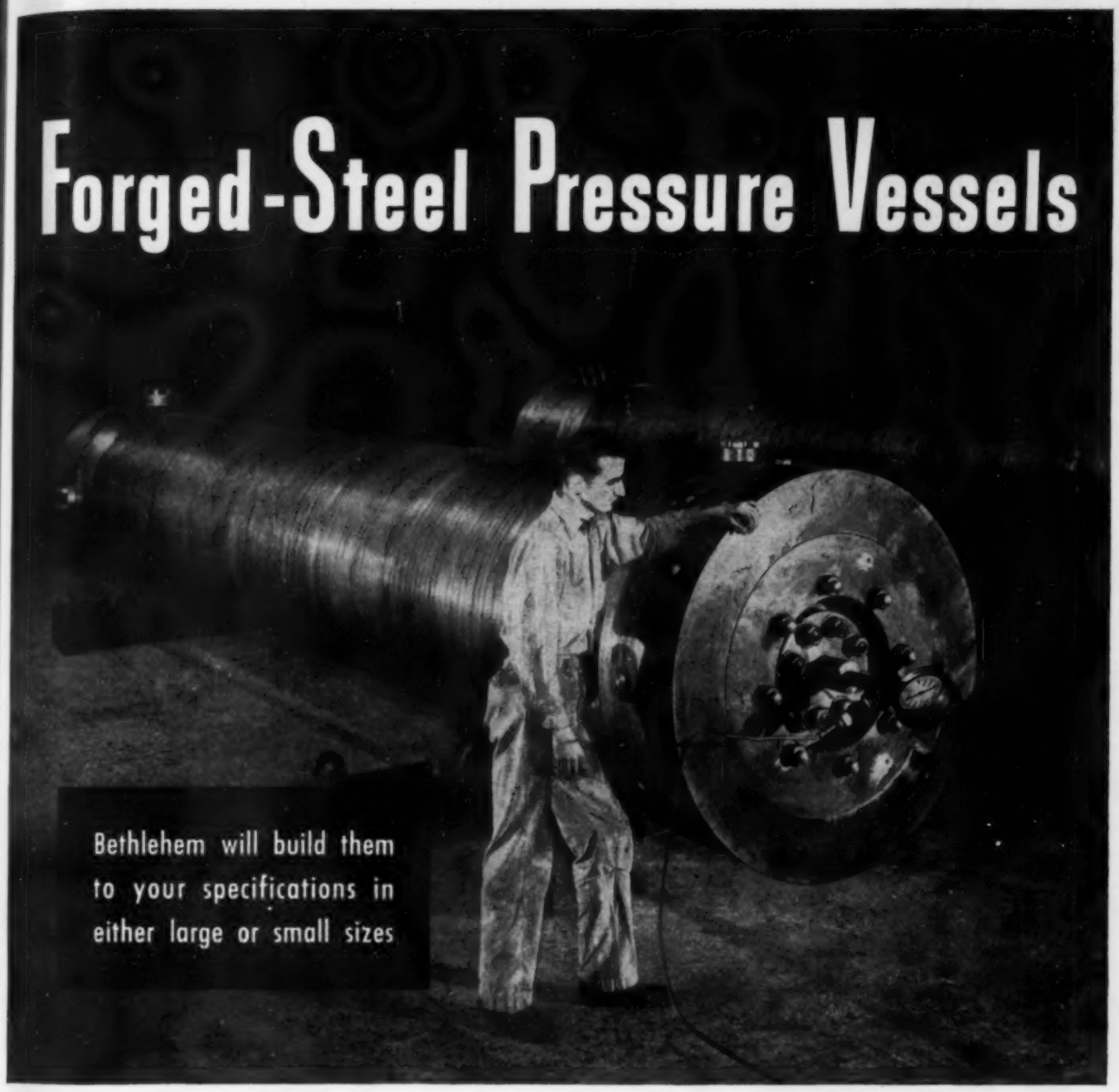

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U. S. Production of Certain Organic Chemicals (Cont. from page 326)

December 1947, December 1946, Twelve Month Totals for 1947 and 1946

	December 1947	December 1946	Total, Twelve Months 1947	Total, Twelve Months 1946
Aniline	8,876,212	7,807,312	107,084,871	89,134,004
5-Ethyl-5 phenylbarbituric acid and salts (phenobarbital)	47,736	45,368	484,513	396,030
Benzene:				
Motor grade:				
Tar distillers[4]	.....	630,575	.....	9,034,500
Coke-oven operators[5]	1,092,684	1,485,629	16,006,822	29,717,732
All other grades:				
Tar distillers[4]	2,233,683	1,328,664	21,871,388	19,957,913
Coke-oven operators[5]	13,832,467	9,782,518	144,219,955	107,826,300
Butyl alcohol primary, normal	9,992,887	13,857,214	138,816,908	125,812,133
Carbon bisulphide	31,263,951	28,867,536	386,379,020	302,543,024
Carbon tetrachloride	18,176,887	11,606,269	199,372,482	145,765,851
Chlorobenzene, mono	26,705,020	24,449,087	324,167,887	268,638,184
Creosote oil:				
Tar distillers[4]	11,004,472	10,631,726	122,241,102	112,238,802
Coke oven operators[5]	3,258,969	2,949,484	39,299,547	29,543,068
Creosols, meta-para	612,636	311,349	6,440,035	5,493,714
Cresols, ortho-meta-para	635,491	331,349	8,731,242	5,493,714
Cresylic acid, refined[7, 10]	2,094,170	925,566	25,946,560	.....
Dibutyl phthalate	1,760,022	1,816,880	21,675,755	23,446,483
Dichlorodiphenyltrichloroethane (DDT)	2,617,458	3,904,814	47,474,937	44,577,955
Ethyl acetate (85 percent)	8,650,601	9,602,012	85,538,749	95,765,181
Ethylene glycol	24,953,231	.....	226,678,930	.....
Ethyl ether	3,632,271	3,436,686	41,213,616	39,922,279
Formaldehyde (37 percent by wt.)	41,455,494	39,424,828	513,867,808	460,048,399
Hexachlorocyclohexane	1,279,964	.....	7,483,785	.....
Methanol, natural[8]	1,707,476	1,176,402	16,764,686	15,888,100
Methanol, synthetic	47,802,839	43,196,241	541,501,071	491,635,382
Naphthalene:				
Tar distillers, less than 79° C	16,019,157	17,593,649	219,578,940	184,965,681
Tar distillers, 79°C and over	8,367,931	7,324,059	97,415,889	95,565,766
Coke-oven operators, less than 79°C	4,832,535	5,760,449	96,664,686	70,080,612
Penicillin and salts[9]	5,804,761	2,654,893	41,404,420	28,106,601
Phenol	25,144,341	19,597,615	268,460,196	199,138,233
Phthalic anhydride	12,892,500	10,343,663	140,981,126	108,708,877
Styrene, government and private plants	29,726,885	34,967,400	310,157,481	374,866,570
Toluene:				
Coke oven operators	2,700,909	1,775,968	27,352,904	16,943,486
All other	3,126,092	2,619,750	36,908,722	16,987,966
Xylene, crude	4,039,772	.....	40,431,026	.....

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

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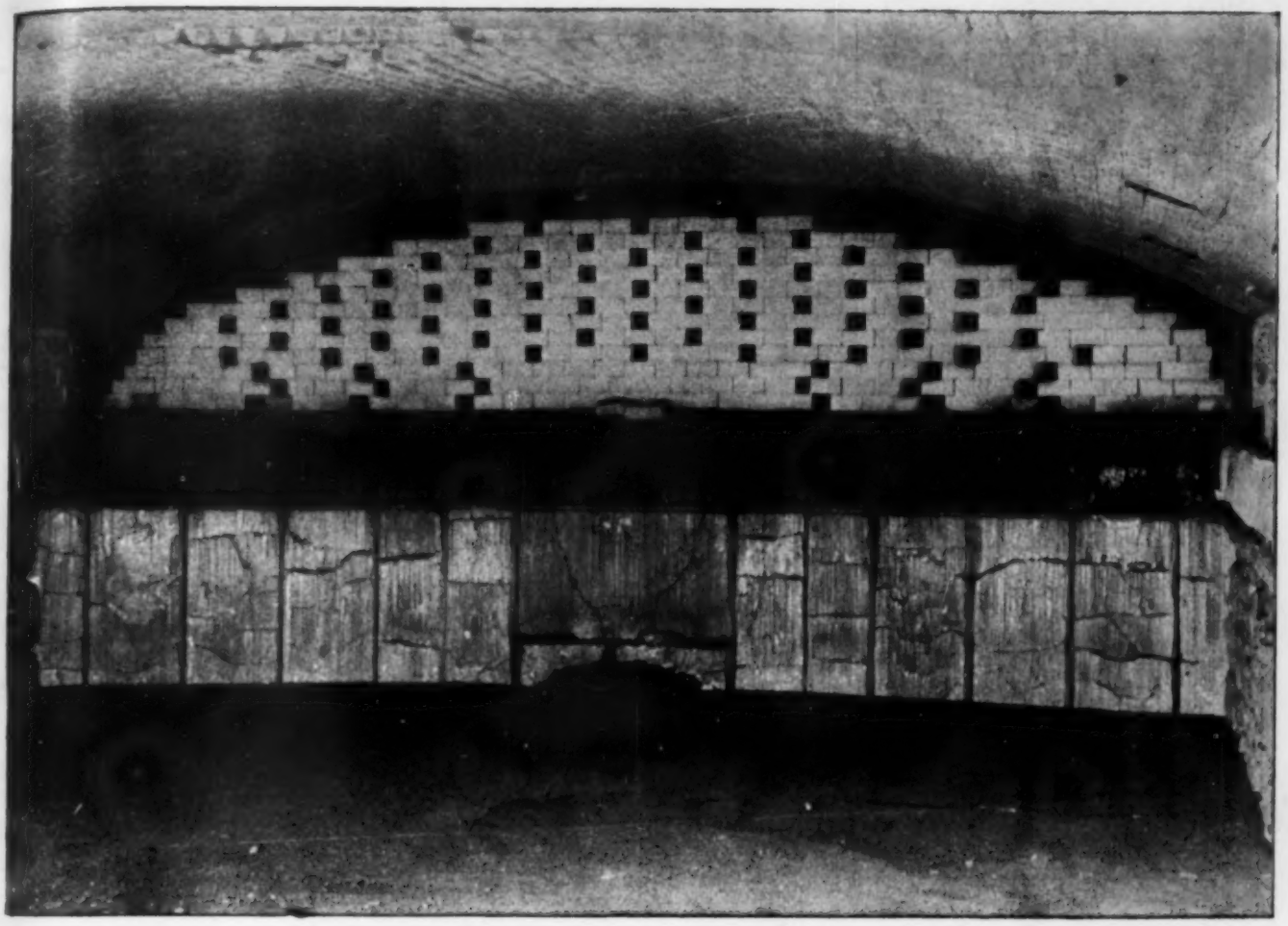

Good Design, Good Operation
Good Refractories, Good Results!

OPERATING DATA

Sq. Ft. Melting Area	585
Total Operating Days	626
Idle Days	190
Total Days (Life)	816
Tons of Glass Melted	86659.1
Tons Glass per Sq. Ft. (ME) for Total Life	148.1
Sq. Ft. per Ton per Day (Operating Days)	4.22
Sq. Ft. per Ton per Day (Total Life)	5.5
Tons Coal Used	31085
Tons of Coal Per Ton of Glass (Total Life)	.359

The photograph above shows the bridgewall and throat of a continuous tank which recently completed a campaign on flint bottle glass.

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Order from Editorial Department

CHEMICAL ENGINEERING
330 West 42nd St., New York 18, N. Y.

Uses of Specially Denatured Alcohol, for Fiscal Year Ended June 30, 1947

	Number of Permittees	Amount Used, U. S. Gal. New[1]	Recovered[2]
Used as Solvent			
Cellulose, resin, and related products	490[3]	9,295,924	4,483,413
Solvent and thinners	60[3]	21,430,787	586
Toilet preparations	1,416[3]	6,079,151	559
Processing of:			
Nitrocellulose (dehydration)	5	5,821,506	25,666,429
Sodium hydrosulphite	4	209,857	12,306,338
Wood rosin and synthetic resins	5	1,088,106	14,858,021
Petroleum oils	11	876,892	10,640,041
Pectin	3	81,414	3,046,026
Food products other than pectin	8	11,353	8,120
Drug products	308	2,384,724	11,855,102
Dyes and intermediates	11	856,007	495,767
Perfume materials and fixatives	11	42,986	104,396
Photographic developers	6	63,262	9,006
Miscellaneous chemicals	38	490,225	4,577,709
Miscellaneous	17	246,082	752,000
Pharmaceutical products for external use	584[3]	2,845,211	373
Cleaning, preserving and flavoring preparations	504[3]	1,343,849	9,086
Used as Raw Material to Produce Other Chemicals			
Vinegar	66	3,864,186	3,580
Acetic acid	3	3,748,787	.....
Ethyl acetate	11	7,398,187	1,300,709
Ethyl chloride	4	1,026,422	.....
Other ethyl esters	61	3,001,015	1,576,361
Dyes and intermediates	7	114,564	251,343
Aldehydes	6	65,550,902	20,435,330
Ether, ethyl	8	916,808	3,299
Ethers, glycol and others	3	1,955,214	12,610,970
Ethylene dibromide	2	1,807,721	40,707
Xanthates	5	594,206	.....
Fulminate of mercury	6	51,569	2,286
Ethylene gas	5	218,897	3,973
Synthetic rubber	2	9,259,489	230,013
Rubber accelerators	1	54	.....
Miscellaneous	43	3,331,973	241,723
Used as Fluid, Fuel, and Laboratory Reagent			
Fluid (anti-freeze and others)	85[3]	276,039	405,171
Fuel[4]	13[3]	178,960	.....
Laboratory and experimental purposes	1,876[3]	540,700	5,533
Total	4,236[3]	157,090,209	126,064,430

[1]Represents quantity of alcohol used for the first time, whether or not any quantity is subsequently recovered. [2]Represents quantity of alcohol reused after recovery from processes where the alcohol has not become a part of the finished products. Such alcohol may have been recovered during the fiscal year 1947 or prior thereto and from any of the listed processes. [3]Each permittee is counted only once in any group of products or uses although such permittee may be included in two or more of the items in such group. Likewise, each permittee is counted only once in the grand total although such permittee may be included in two or more groups of products or uses. [4]Prior to 1947 included quantity used in manufacture of airplane fuel. None used during fiscal year 1947. Source: Bureau of Internal Revenue.

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NEW CONSTRUCTION

Proposed Work

Ind., Ft. Wayne—U. S. Rubber Co., 4300 New Haven Ave., plans to remodel its 1 story, 520x720 ft. plant. J. Gordon Turnbull, Inc. 2630 Chester Ave., Cleveland 14, O., Archt. Estimated cost $75,000.

Ind., Terre Haute—Commercial Solvents Corp., 1331 South First St., plans to construct a manufacturing plant to include a 3 story research building, 2 story high pressure pilot plant, 2 story bacteriological pilot plant and 2 story pharmaceutical laboratory. Miller & Vrydagh, 200 Opera House Bldg., Archts. Estimated cost $2,000,000.

Kan., Ulysses—Magnolia Petroleum Co., Wichita, plans to construct a natural gasoline plant to have a peak capacity of 100,000,000 cu. ft. daily; 19,000 gal. gasoline and 15,000 gal. liquified petroleum gases daily. Estimated cost $7,500,000.

La., Marrero—Petco Corporation, Marrero, plans to construct skimming and cracking plant units. Estimated cost $900,000.

N. Y., Niagara Falls—International Graphite & Electrode Corp., Packard Rd., plans to construct a furnace building. Estimated cost $176,500.

Ohio, Marion—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., and Central Research Dept., Dayton, O., plans alterations, improvements and additions to existing buildings on 1,200 acre tract part of Sciota Ordnance Works near Marion to be used for establishment of new atomic energy installation to be operated by Monsanto Chemical Co. as a unit for Atomic Energy Commission. Estimated cost $5,000,000.

Okla., Tulsa—Texas Co., Philtower Bldg., plans additions to West Tulsa Refinery. M. W. Kellogg Co., 225 Broadway, New York, N. Y., Engr. Estimated cost $1,000,000.

Tex., Big Spring—Cosden Petroleum Corp., Big Spring, plans to construct a catalytic cracking plant. Estimated cost $1,500,000.

Tex., Carthage—United Gas Pipe Line Co., subsidiary of United Gas. Corp., United Gas Bldg., Houston, plans to construct a gasoline plant here. Estimated cost $3,500,000.

Tex., Dallas—The Paraffine Companies, Inc., Liberty Bank Bldg., plans to construct a paint plant. Estimated cost $100,000.

Tex., Houston—Gulf Portland Cement Co., Penn City Rd., plans to enlarge its plant on the Ship Channel to manufacture cement from oyster shells. Estimated cost $1,000,000.

Tex., Jacinto City—Houston Asbestos Co., 1526 Welch St., Houston, plans to double the capacity of its plant here. Estimated cost $250,000.

Tex., Waco—General Tire & Rubber Co., 1708 East Market St., Akron, O., and Waco, plans to enlarge its existing plant. Estimated cost $200,000.

	Current Projects		Cumulative 1948	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	.....	$325,000
Middle Atlantic	$176,000	$138,000	$2,276,000	10,395,000
South	968,000	30,680,000	56,035,000	8,817,000
Middle West	7,075,000	180,000	11,850,000	5,915,000
West of Mississippi	15,050,000	1,663,000	110,410,000	20,503,000
Far West	.....	362,000	9,650,000	21,704,000
Canada	19,090,000	70,000	30,590,000	11,795,000
Total	$42,359,000	$33,093,000	$220,811,000	$79,454,000

Va., Elkton—Merck & Co., Lincoln Ave., Rahway, N. J., plans to alter and construct additions to its processing plant. Lockwood-Greene Engineers, 10 Rockefeller Plaza, New York 20, N. Y., Engr.

British Columbia—H. R. MacMillan Export Co., Ltd., 837 West Hastings St., Vancouver, plans to construct a new plant to produce up to 250 tons of bleached sulphate pulp a day from waste of Douglas fir, hemlock and cedar logging, on the east coast of Vancouver Island. Estimated cost $12,000,000.

Ont., St. Thomas—Haines Ceramico, Ltd., St. Thomas, plans to construct a ceramic products plant. Estimated cost $90,000.

Ont., Toronto—Lever Bros., Ltd., 229 Eastern Ave., plans to construct additions to its plant. Stone & Webster Engineering Corp., 147 University Ave., Toronto, Engr. Estimated cost $7,000,000.

Contracts Awarded

Ala., Birmingham—American Rock Wool Corp., c/o Rust Engineering Co., Liberty National Life Bldg., contractor, will construct an addition to its plant here. Estimated cost $100,000.

Ala., Childersburg—Coosa River Development Co., c/o J. E. Sirrine & Co., Engr., Greenville, S. C., has awarded the contract for a newsprint mill to F. H. McGraw Construction Co., 780 Windsor St., Hartford, Conn., and Daniel Construction Co., 822 7th Ave., S., Birmingham. Estimated cost $30,000,000.

Calif., Los Angeles—Procter & Gamble, 1151 South Broadway, have awarded the contract for a 50x50 ft. plant addition to H. K. Ferguson Co., 1651 West 7th St., at $282,100.

La., Eunice—Kelly, Weber & Co., Lake Charles, have awarded the contract for the construction of a fertilizer plant to Albert Tate & Associates, Ville Platte, La. Estimated cost $130,000.

Mo., St. Louis—Monsanto Chemical Co., 1700 South Second St., has awarded the contract for a 1 story, 160x162½ ft. addition to its plant to Gamble Construction Co., 804 Pine St. Estimated cost $300,000.

Mo., St. Louis—Pioneer Paper Co., 1912 Pine St., has awarded the contract for a 1 story, 109x125 ft. brick warehouse to E. E. Marx, 3615 Olive St., St. Louis.

N. C., Greensboro—Sears, Roebuck Co., Greensboro, has awarded the contract for a 4 story paint and varnish factory to Southeastern Construction Co., 301 West Second St., Charlotte, N. C. Estimated cost $450,000.

O., Bedford—Pesco Products Co., 11610 Euclid Ave., Cleveland, has awarded the contract for a laboratory to form the nucleus of a group of buildings, on North Miles Ave., to Sam W. Emerson Co., 1836 Euclid Ave., Cleveland. Estimated cost $100,000.

Ohio, Cleveland—Glidden Co., 11001 Madison Ave., has awarded the contract for a 2 story, 28x62 ft. addition to its factory to J. C. F. Shafer Co., Caxton Bldg. Estimated cost $80,000.

Okla., Alex—Magnolia Petroleum Co., Magnolia Bldg., Dallas, will construct a natural gasoline recycling plant and pipeline. Work will be done with own forces. Estimated cost $750,000.

Pa., Philadelphia—Crescent Ink & Color Co. of Pennsylvania, 460 North 5th St., has awarded the contract for two 2 story additions to its factory to Haverstick & Borthwick Co., Schaff Bldg. Estimated cost $70,000.

Pa., Philadelphia—Pioneer Paper Stock Co., 22nd and Westmoreland Sts., has awarded the contract for a warehouse and office addition to its plant to Burns Lafferty, 8136 Germantown St. Estimated cost will exceed $68,000.

Tex., Sabine—Menhaden Fisheries Co., c/o B. H. Halter, Port Arthur, will construct a fertilizer plant. Work will be done by owners. Estimated cost $155,000.

Tex., Withers—Texas Co., Texas Bldg., Houston, has awarded the contract for a compressor plant to Brown & Root, Inc., 4300 Calhoun Rd., Houston. Estimated cost $390,000.

Wash., Vancouver—Carborundum Co., Niagara Falls, N. Y., has awarded the contract for a carborundum plant to Nicholson Co., Inc. 10 Rockefeller Plaza, New York, N. Y., and chemical plants division of Blaw-Knox Co. Farmers Bldg., Pittsburgh, Pa. Estimated cost $80,000.

B. C., Vancouver—Canada Pulp Products, Ltd., Granville Island, has awarded the contract for a new plant for cellulose sponge factory to Canada Pulp Products, Ltd., Granville Island. Estimated cost $70,000.